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AERONAUTICAL SYSTEMS DIVISION
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This technical report has been reviewed and is approved for publication.

JAMES H. HALL
Colonel, USAF
Deputy for Development Planning

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The Aeronautical Systems Division Infrared Signature Prediction Program (ASDIR) is a state-of-the-art functionally modularized computer code. Volume II contains a functional and technical description of each of the programs used in ASDIR as well as a complete program listing.

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ASDIR-II PROGRAM DESCRIPTION

INTRODUCTION

This Program Description outlines the structure of ASDIR-II in order to give the users the essential knowledge required for program implementation, use and modification. Simplified structural and flow diagrams of the major programs and short functional descriptions of all programs and subroutines are given to help describe ASDIR. The level of detail presented in this manual is consistent with the availability of reference and documentation material, program difficulty or program impact on overall computational accuracy.

Essentially this manual is written in the same order as the calling sequences in ASDIR, with modification only when structural considerations and clarity dictate.

Please note, this manual is intended as an aid to the user to allow better understanding of each program's function and not as a users manual (see ASDIR-II, Volume I - USERS MANUAL).

GENERAL PROGRAM DESCRIPTION

The Aeronautical Systems Division's InfraRed Signature Prediction Model (ASDIR) is a computer code utilizing the overlay structure shown in figure 1. These overlays are organized into three major functionally modularized computational groupings, figure 2: (1) Hot Parts Analysis; (2) Plume Gas Dynamics; and (3) Signature Prediction. A fourth overlay element establishes the required data initialization and input/output operational capabilities.

This volume is organized in the following functional format:

1. ASDIR 2 - Program Control
2. Data Initialization & I/O
3. Hot Parts Analysis
4. Plume Gas Dynamics
5. Signature Prediction
6. Program Listing in Overlay Form

PROGRAM:	ASDIR 2 (Page A-4)
FUNCTION:	This program is the main controlling routine of ASDIR (the Aeronautical Systems Division InfraRed Signature Prediction model). ASDIR's prime function is to provide a logical sequence of calls to the functional programs.
INPUT:	None
OUTPUT:	None
SUBROUTINES:	All overlays and data blocks
DESCRIPTION:	See figures 1 and 2 and program listing on page A-4.

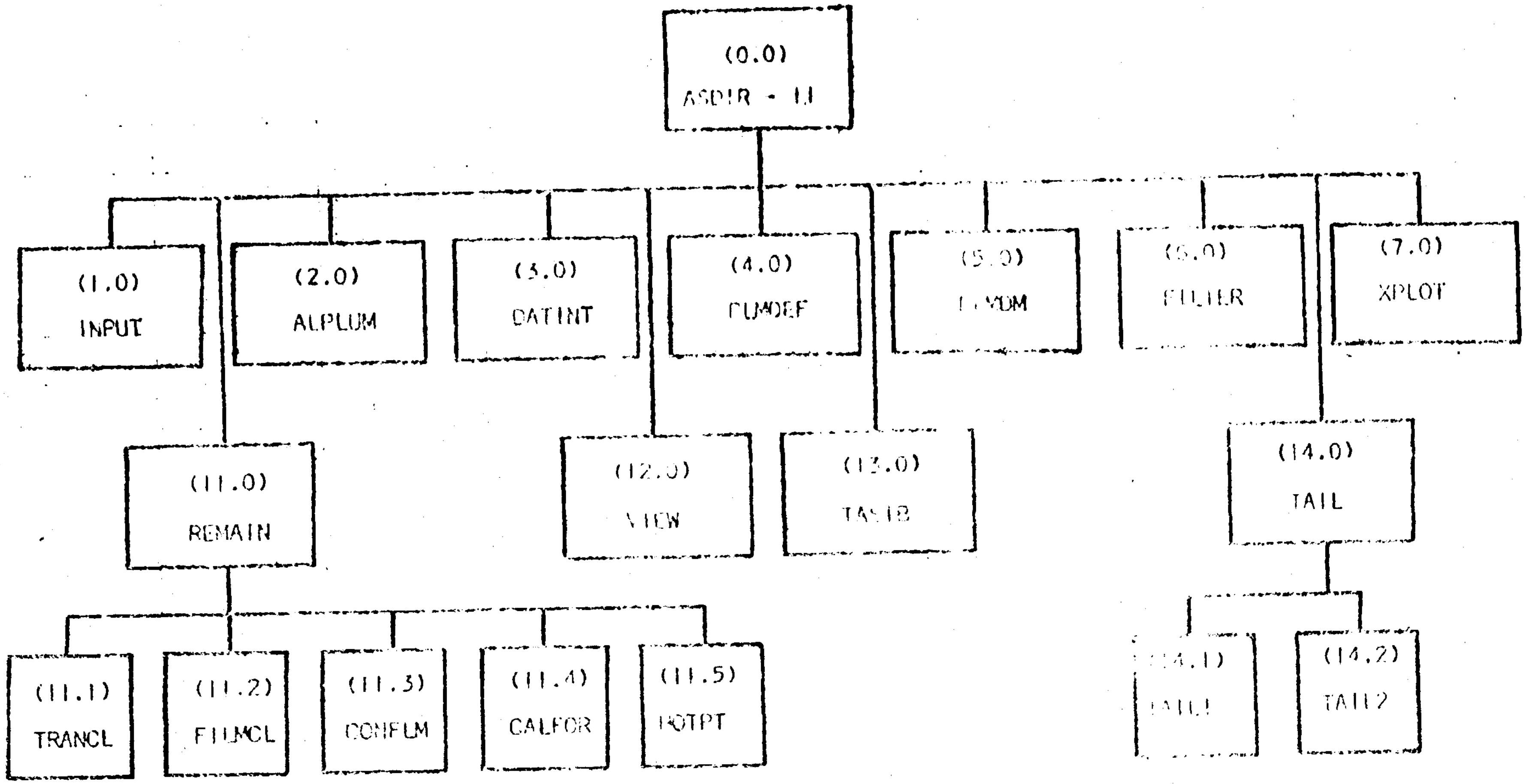


FIGURE I. ASDIR-II OVERLAY STRUCTURE

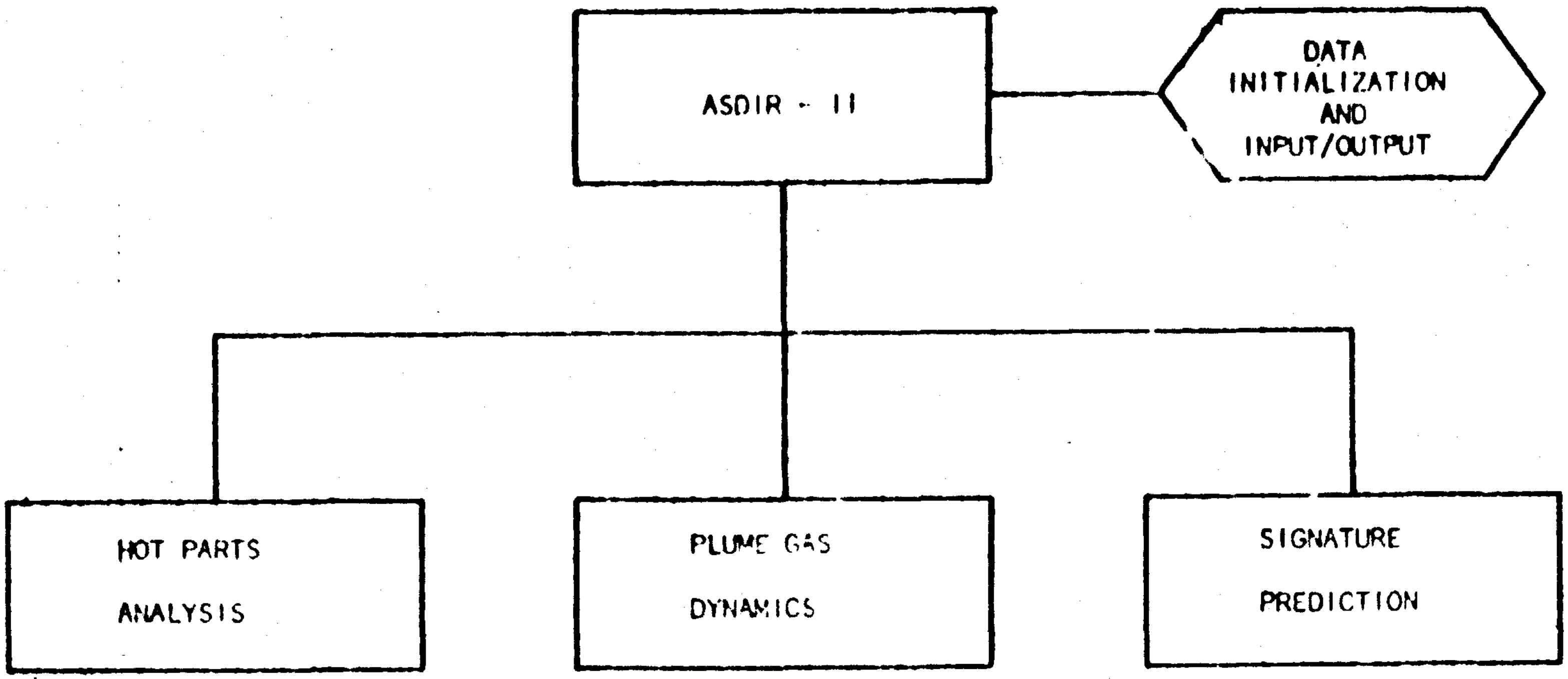


FIGURE 2. ASDIR-II FUNCTIONAL STRUCTURE

PROGRAM: INPUT (Page A-43)

FUNCTION: Provide a vehicle by which the desired calculation parameters, case definition and data initialization can be read into ASDIR.

INPUT: All control and computational variables in the CASE namelist.

OUTPUT: Computationally compatible case and dimensional data.

SUBROUTINES: None

DESCRIPTION: See ASDIR-II Volume I, User's Guide, for complete description of the namelist variables.

PROGRAM: DATINT (Page A-79)

FUNCTION: To initialize the calculation parameters.

INPUT: None

OUTPUT: Initialized calculation parameters

SUBROUTINES: None

DESCRIPTION: This program has been written to initialize the common block data to the default case. See ASDIR-II, Volume I, User's Guide for default options. A secondary function of this program is to allow use of ASDIR on systems in which a zero core initialization is not available.

PROGRAM: FILTER (Page A-106)

FUNCTION: Provides a means of accessing stored filter response data or entering a filter response of the user's choice.

INPUT: Filter number or filter band width and response.

OUTPUT: Filter response.

SUBROUTINES: None

DESCRIPTION: Stored filter responses are in data statements with modification possible through namelist FILT. This program also can be used to initialize the wavenumber calculation intervals.

PROGRAM:	XPLOT (Page A-109)
FUNCTION:	To provide a means of file manipulation for either punching or printing spatial signature data.
INPUT:	Calculated spatial signature data.
OUTPUT:	Punched or printed spatial data.
SUBROUTINES:	None
DESCRIPTION:	This program requires the use of a punch file and an addition file TAPE 8.

PROGRAM: Block Data H2O (Page A-15)

FUNCTION: Data Block for water vapor band parameters.

INPUT: None

OUTPUT: None

SUBROUTINES: None

DESCRIPTION: See References [1, 2, 3]

PROGRAM: Block Data CO2 (Page A-7)

FUNCTION: Data Block for carbon dioxide band parameters.

INPUT: None

OUTPUT: None

SUBROUTINES: None

DESCRIPTION: See References [1, 2, 3

PROGRAM: SIGNIR

FUNCTION: To calculate the hot parts signature and descriptive parameters required in ASDIR.

INPUT: Engine description, gas properties and case definition (See ASDIR-II, Volume I, User's Manual).

OUTPUT: Primarily the information which is transferred from the SIGNIR link to ASDIR is an equivalent black body area and equivalent black body temperature.

SUBROUTINES: See Figure 3.

DESCRIPTION: With the exception of the modifications required to adapt SIGNIR to the ASDIR format the hot parts calculations are performed with the original LTV/SIGNIR-I computer code. This code was chosen for only one reason; it has proven to be the best available methodology to predict engine hot metals signatures regardless of program size, operating cost or complexity.

The description of the infrared signature prediction program (SIGNIR) is provided by the following discussions which cover a general description of the program, the program computational procedure and the analytical methods utilized in obtaining the solution.

The program SIGNIR is a digital computer program written for the purpose of providing predictions of the hot metal infrared emission from aircraft engine exhaust systems. The program is designed to be applicable to axi-symmetric turbojet, turbofan, or turboshaft engine exhaust systems. It predicts the spectral intensity of the radiant energy emitted from exhaust system hot metal in the wavelength band of from one to 15 microns. In general, the information required by the program is as follows:

- Exhaust system physical characteristics
- Engine operating conditions
- Special surface cooling flow conditions
- Exhaust system surface properties

The predictions provided by the progi im for the combination of a selected maximum of 20 engine off-axis angles are:

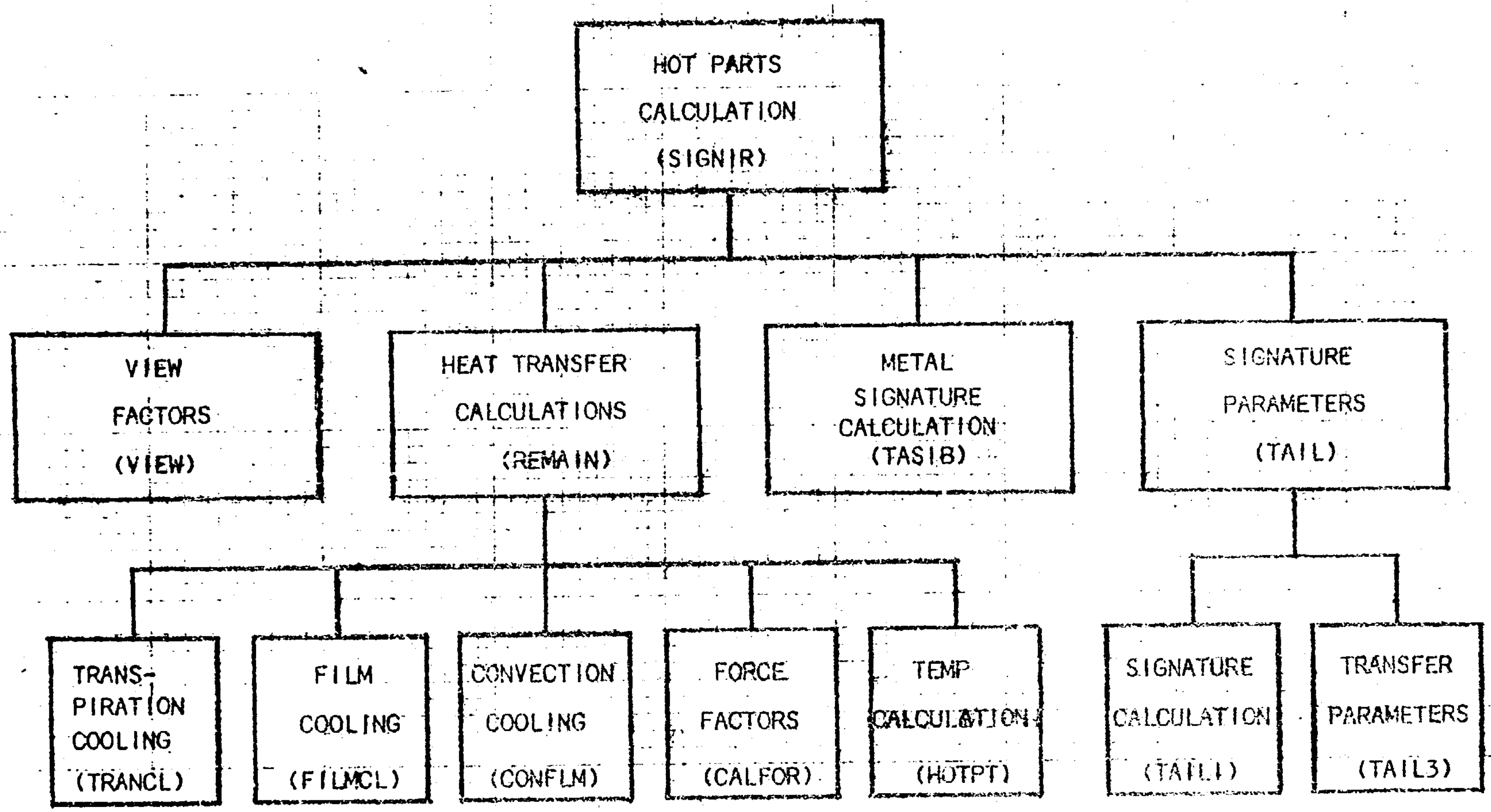


FIGURE 3. HOT PARTS ANALYSES

- Spectral radiant intensity nonattenuated by the atmosphere
- Selected radiant intensity bandwidth summations nonattenuated by the atmosphere

Optional exhaust system information which can be requested from the program is:

- Internal fluid flow properties
- Surface boundary layer data
- Internal and external geometric radiation view factors
- Surface temperature distribution
- Thrust information

The process of computing the intensity of the infrared energy emitted from aircraft exhaust system hot metal requires a knowledge of the metallic surfaces temperature, emissive properties and their relative physical positioning within the system. From this information, the radiant energy emitted and reflected from the exhaust system to a point in space can be determined. The computational procedure established by this program for the prediction of exhaust system hot metal infrared radiation is shown by major subjects in the general block diagram presented on figure 3.

The input data required by the program provides a physical model (nodal system) of the exhaust system configuration, the properties and conditions of the exhaust gases entering the system, band width and location relative to the exhaust system. The program undertakes a one-dimensional, isentropic, compressible flow analysis which generates the axial distribution of exhaust gas flow conditions and properties within the system. Where two gas streams at different temperatures flow within a single passage, compound flow considerations are utilized. The program adjusts the flow at the nozzle throat to balance with the ambient pressure or a chocked condition dependent on the system's entrance flow data.

With the internal flow properties defined, a surface boundary layer analysis is conducted to obtain the coefficients of convection and friction along each surface within the system. This analysis is primarily dependent on the surface's axial static pressure distribution and the upstream boundary layer conditions. An area weighted average coefficient of convection for each of the model's surface nodes (isothermal regions established by the input data) is computed for the system thermal analysis. The axial force on each surface, internal to the system, is computed utilizing both the frictional and pressure-area forces.

Descriptions of the routines associated with SIGNIR are presented in Table 1. Further definitions of the routines can be found in ASDIR-II, Volume III, Reference Documentation or in Reference [4].

The program SIGNIR, other than a few minor programming changes, remains as developed by LTV. The only link between SIGNIR and ASDIR-II is Common Block OUT, containing the following information:

- Equivalent Black Body Area, CM^2
- Equivalent Black Body Temperature, deg-K
- Viewing Aspect Angles, degrees off tail
- Number of Aspect Angles

TABLE 1

DESCRIPTION OF SIGNIP ROUTINES

ROUTINE NAME	BASIC FUNCTION	PAGE
ARCCOS	Determines the angle, in radians, corresponding to a given cosine value. The angle will be from zero to $\pi/2$ radians.	A-176
ARRAY	Describes in two-dimensional coordinates the inner and outer surfaces of the flow streams using the surface node coordinates.	A-38
AVER	Averages the cooling wall temperatures for the surface nodes along the cooled portion of the configuration surfaces; prints these averages.	A-118
AVERFS	Determines the average values of the parameters necessary for force factor (pressure area and friction forces) calculations for each surface node along the configuration surfaces.	A-160
AVERHT	Determines and prints the average heat transfer coefficient for each surface node along the configuration surfaces.	A-151
AXAREA	Determines the cross-sectional area of the fluid flow streams as a function of the configuration axial distance.	A-126
BODY	Determines for the internal view factors, if the line of sight between points on two nodes is tangent to a shadowing body.	A-186
CALFOR	Prints the average force factor for each surface node and calculates and prints the total net surface force factor for the configuration.	A-148
CANSEE	Checks, for internal view factors, the visibility between two nodes to determine if shadowing may occur.	A-184
CEDIT	Selects the convection and conduction heat paths from input data and forms the conduction matrix.	A-203
CHECK	Checks the data returned from routine BODY for extraneous solutions.	A-188

TABLE 1 (Cont)

ROUTINE NAME	BASIC FUNCTION	PAGE
CODE	Analyzes the results provided by routine FINDIT to describe the nature of shadowing between two nodes.	A-183
COFLOW	Calculates the compressible flow properties for the flow streams as a function of pressure. Adjusts the flow for cooling or ambient pressure at the exit of the configuration.	A-122
COND	Reads in those values of heat transfer and fluid lump temperatures for nodes whose thermal paths are not connected with the fluid streams.	A-40
CONFLM	Calculates a pressure balance and surface temperatures for a surface cooled by convection-film cooling for either counter or parallel flow. Prints the coolant mass flow rate and pressure.	A-139
CPAGMA	Calculates the specific heat at constant pressure as a function of temperature for routine HEAT and the specific heat ratio as a function of Mach number of routines RIMAIN and HEAT.	A-128
CRODEL	Computes Kroneker Delta for matrix solutions.	A-196
CUBIC	Determines the real roots of a third order equation.	A-178
DINVRT	Computes the matrix inversion and accompanying solution for linear equations.	A-199
DIS	Computes the distance between two given coordinates.	A-215
FEDIT	Selects the radiation view factor data from the input data and forms the radiation matrix.	A-202
FILMCL	Calculates a pressure balance and surface temperatures for a film cooled surface. Prints the coolant mass flow rate and pressure.	A-134

TABLE I (Cont)

ROUTINE NAME	BASIC FUNCTION	PAGE
FINDIT	Locates the axial positions of two nodes with respect to the axial positions of the configurations surfaces.	A-182
FLOWNO	Checks the resulting pressure for surface cooling against the static pressure along the cooled surface. Prints a warning diagnostic for areas of no cooling flow.	A-119
GATHER	Combines data from routines AXAREA and COFLOW to form the compressible flow properties for the configuration flow streams.	A-127
HEAT	Calculates the initial conditions necessary for the boundary layer calculations.	A-153
HEATTR	Calculates the convection heat transfer coefficient.	A-159
HOTPT	Routine to control the calculation of surface boundary layers and heat transfer coefficients.	A-149
MATPOS	Checks to ensure that all the elements for convection and radiation matrices are positive.	A-197
MATSYM	Completes the matrices for the convection heat paths and the radiation view factor area product.	A-198
MINV	Inverts the "Script F" matrix.	A-222
ORDER	Arranges two-dimensional coordinate arrays into increasing order according to a selected variable.	A-39
PICMAX	Determines the maximum value of an array of up to twenty numbers.	A-190
PICMIN	Determines the minimum value of an array of up to twenty numbers.	A-191
PLANCK	PLANCK Black body function.	A-219
PLOT1	Generates a plot of radiant intensity vs. wavelength for both the non attenuated and the atmospheric attenuated radiation data.	A-206

TABLE 1 (Cont)

ROUTINE NAME	BASIC FUNCTION	PAGE
PRNDT1	Calculate the Prandtl number as a function of termperature for routine CONFLM.	A-147
PRNDTL	Calculates the Pradtl number as a function of temperature for routines TURBLT and RIMAIN.	A-129
PSOLN	Generates surface cooling flow supply and discharge characteristics and solves these simultaneously for calculation of the available surface cooling mass flow rate and pressure.	A-120
QUAD	Determines the roots of a second order equation.	A-177
REDI	Computes the spectral radiant intensity (watts/Steradian) for each engine off-axis angle.	A-220
REDII	Computes and prints geometric view factors for a detector to the configurations surface nodes as a function of engine off-axis angle.	A-210
REMAIN	Control routine for the fluid flow, heat transfer, surface cooling and surface force factor calculations. Prints the fluid flow information.	A-110
RING	Determines the intersection of a shadowing body with the "cone of vision" that a point on one node sees another node.	A-189
RITE	Used to print the heading information for routine REDII.	A-216
RITER1	Prints the surface radiation information.	A-224
SCRPTF	Computes internal radiation interchange factors for the thermal analyzer.	A-204
SETFLO	Determines the pressure balance for the surface cooling routines if a cooling mass flow rate is specified.	A-133, A-138
SHADOW	Describes the configuration surfaces used for shadowing in routine VIEW in a manner compatible for shadowing surface description of routine REDII.	A-209

TABLE 1 (Cont)

ROUTINE NAME	BASIC FUNCTION	PAGE
SIGNIR	The programs main routine. Controls the flow throughout the entire program.	A-32
STORE	Temporarily stores information necessary for average heat transfer coefficient calculations.	A-125
STORE1	Temporarily stores information necessary for force factor calculations.	A-124
STRATE	Computes solution utilizing linear interpolation routine used in describing the configuration surface data for boundary layer calculations.	A-121
SUMAT1	Summates and prints the radiant intensity for selected wavelength bands.	A-225
TABLEL	Computes solution utilizing second order interpolation of data and provides the first derivative of the interpolated function.	A-36
TAIL	Interface parameter generation and I/O program control routine.	A-205
TAIL1	Metal signature calculation control routing.	A-208
TAIL2	I/O and interface parameter calculation control routine.	A-218
TAS1R	Controls program flow and data involved in calculating the radiation interchange factor matrix, conduction matrix, performing the thermal balance and printing the wall temperature for each node.	A-193
TEST1	Tests the possibility of one node being shadowed by a second node which has the same axial location.	A-180
TEST2	Determines whether a point lies between two other points.	A-181
TESTN	Computes the last computed value of geometric view factor with the previously computed value to determine whether the view factor needs to be recalculated using finer divisions of the nodes. This routine also sets these divisions.	A-192

TABLE 1 (Cont)

ROUTINE NAME	BASIC FUNCTION	PAGE
TITLA	Controls output printing of the title page.	A-41
TRANCL	Calculates a pressure balance and wall temperatures for a transpiration cooled surface. Prints the coolant mass flow rate and pressure.	A-130
TURBLT	Calculates and prints the boundary layer and heat transfer information as a function of configuration axial distance.	A-154
VECANG	Calculates the angle of a node relative to the configuration center line.	A-217
VIEW	Calculates and print for each configuration node, internal geometric veiw factors.	A-162
WRIT14	Transfers a two-dimensional array into a single dimensional array.	A-201

The equivalent Black Body Area and Temperature are extracted from the data generated by SIGNIR. The first step is to determine the equivalent Black Body Temperature. This is accomplished by searching the generated spectral data for the maximum intensity, figure 4, and applying the Wien Displacement Law:

$$T_{BB} = \frac{2897.9}{\lambda_{max}} \quad \mu\text{-}^{\circ}K$$

The equivalent Black Body Area is found by dividing the integrated signature obtained from SIGNIR by the Radiant Exitance over the band of interest.

$$A_{BB} = \int_{\lambda_1}^{\lambda_2} M_e(\text{SIGNIR}) \;/\; \int_{\lambda_1}^{\lambda_2} M_e(T_{BB})$$

Figure 5 shows a typical correlation between the predicted spectral signature and the spectral signature of the equivalent black body. These resultant temperatures and areas are the only parameters transferred back to ASDIR.

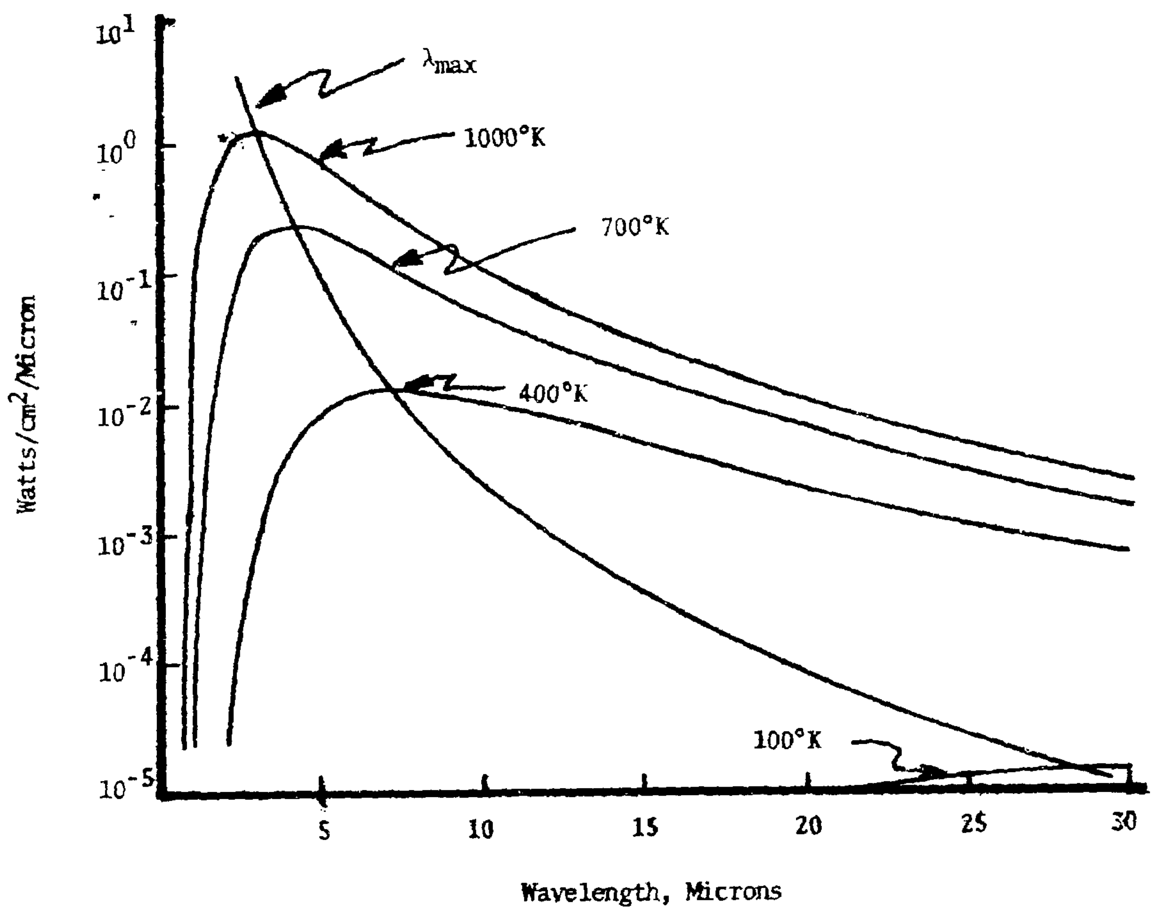


Figure 4. Black Body Curve

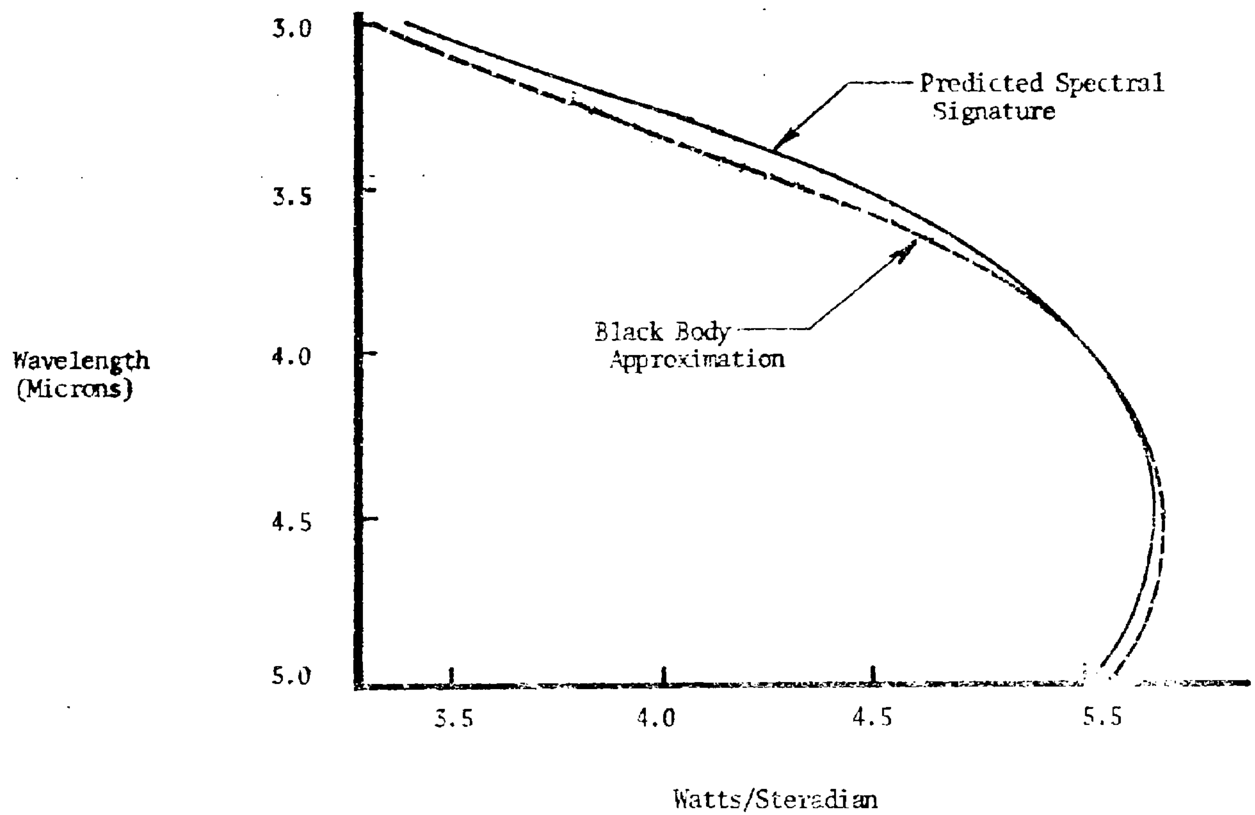


Figure 5. Black Body Correlation

PROGRAM: PLMDEF (Page A-81)

FUNCTION: Plume definition and gas data array development.

INPUT: Engine nozzle exit flow properties (velocity, pressure, temperature, and species [H20, CO2] concentrations) as a function of radius.

OUTPUT: Plume gas data array. At this point, velocity (ft/sec) and pressure (atm x 10^{-3}) are multiplexed into common registers.

SUBROUTINES: FLINP

DESCRIPTION: The gas dynamic calculations made for the plume in this program, figure 6, are applicable to axisymmetric turbojet and turbofan engine with mixed or separate co-annular co-plonar exhaust jets. The finite difference calculations were developed to express the conservation (mass, momentum, energy, and species) laws for numerical integration by General Electric in their early SCORPIO work reported in reference [5]. Two effective kinematic viscosities were retained, one for physical mixing and the other for thermal mixing. The conservation laws were simplified for axisymmetric flow whereby all gradients in rotation about the centerline were not to zero, and all radial components of momentum were neglected as being small. Second axial derivatives and axial gradients divided by the radius were also neglected in momentum. Thermal radiative heat transfer and thermal generation were also neglected. In the derivation of the energy conservation and transfer functions the effects of the second viscosity, the square of axial gradients, dependence upon radial velocity, and gradients divided by the radius were minimized. The radial coordinate system was transformed into a stream function coordinate system after Von Mises. The transformation functions and the transformed conservation relations to which the finite difference procedure was applied are as follows:

Stream Function

$$\Psi\frac{\partial\Psi}{\partial r} = \rho ur \quad ; \quad \Psi\frac{\partial\Psi}{\partial x} = -\rho vr$$

$$\text{wherein: } \frac{\partial\Psi}{\partial r} = -\frac{u}{r} \quad ; \quad \frac{\partial\Psi}{\partial x} = \frac{v}{r}$$

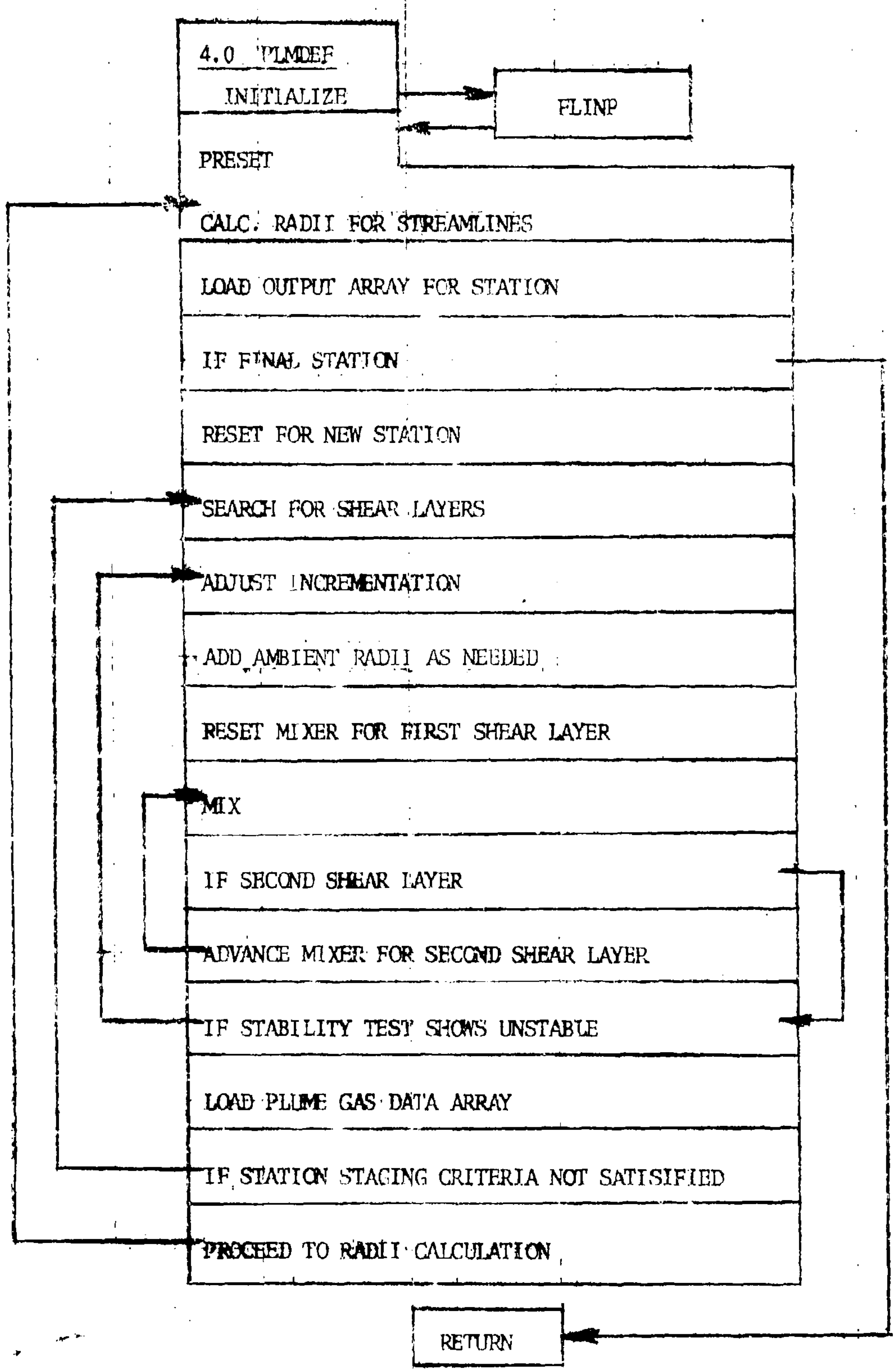


Figure 6. PLMDEF Flow Diagram

CONTINUITY:

for the stream function:

$$\Psi\frac{\partial^2\Psi}{\partial x\partial r} + \frac{\partial\Psi}{\partial r}\cdot\frac{\partial\Psi}{\partial x} - \frac{\Psi\partial^2\Psi}{\partial r\partial x} - \frac{\partial\Psi}{\partial x}\cdot\frac{\partial\Psi}{\partial r} = 0$$

and after the transformation:

$$-\frac{\partial}{\partial x}\left(\frac{\Psi}{\rho ur}\right) + \frac{\partial}{\partial\Psi}\left(\frac{\rho vr}{\rho ur}\right) = 0$$

MOMENTUM:

$$\frac{\partial u}{\partial x} = \frac{1}{\Psi}\cdot\frac{\partial}{\partial\Psi}\left(\frac{\rho^2 ur^2}{\Psi}\cdot\varepsilon\cdot\frac{\partial u}{\partial\Psi}\right) - \frac{dp}{\rho u dx}$$

ENERGY:

$$\frac{\partial T}{\partial x} = \left(\frac{\rho^2 ur^2}{\Psi}\cdot\varepsilon_T\right)\left(\frac{1}{c_p\Psi}\right)\left(\frac{\partial u}{\partial\Psi}\right)^2 + \frac{\partial}{\Psi\partial\Psi}\left(\frac{\rho^2 ur^2}{\Psi}\cdot\varepsilon_T\cdot\frac{\partial T}{\partial\Psi}\right) + \frac{dp}{\rho c_p dx}$$

$$+ \left(\frac{\rho^2 ur^2}{\Psi}\cdot\varepsilon_T\right)\left(\frac{1}{c_p\Psi}\right)\frac{\partial T}{\partial\Psi}\sum\left(c_{pi}\frac{\partial\alpha_i}{\partial\Psi}\right)$$

DIFFUSION:

$$\frac{\partial\alpha_i}{\partial x} = \frac{\partial}{\Psi\partial\Psi}\left(\frac{\rho^2 ur^2}{\Psi}\cdot\varepsilon\cdot\frac{\partial\alpha_i}{\partial\Psi}\right)$$

where:

T = gas static temperature or thermal subscript

u = gas axial velocity

v = gas radial velocity

Prandtl number = $c_p\rho\varepsilon/k = 1$

Schmidt number = $\varepsilon/D = 1$; in which D is the binary diffusion coefficient

ε = effective kinematic viscosity

α_i = species concentration

$\frac{\partial c_p}{\partial r}$ is an assumed radial dependence for the gradient of the specific heat of a mixture of gases = c_p/r.

Other quantities and terms are conventional.

The effective viscosity adopted for ASDIR includes the Donaldson and Gray treatment for the compressible free mixing of two dissimilar gases as reported in the AIAA journal, Vol 4, no. 11, in November 1966 and as applied by General Electric in SCORPIO-II [5].

Overall, the plume model appears to reflect the essential features of measured plume data in those regions where the gas is hot. The regions where the model tends to lose accuracy are toward the outer edges where the gas shear appears to be too small thus allowing the plume to spread excessively. However, the plume temperatures and species concentration are essentially ambient in value so that the radiance and transmittance errors are small.

Viscosity Model

The choice of the turbulent viscosity, ε, is critical to the plume flow field. Past models, available in the literature (Schlicting, Abramovich, Warren and Applied Science Laboratories), show the turbulent viscosity as a function of axial distance and velocities in the mixing region. Preliminary results for the flow field showed that the analysis using these models did not agree with jet engine test data. A modified temperature dependent model for viscosity was formulated to include the temperature effects of hot flow.

The model being used in this analysis is:

$$\varepsilon = x\cdot\{U_1 - U_2\}/[CNST\cdot(T_1/T_2)^2]\cdot\gamma$$

where

$$\gamma = 1 \;;\quad M_c < 0.6$$

$$\gamma = 1.6/(1 + M_c) \;;\quad M_c > 0.6$$

The value for γ is from a paper by Donaldson and Gray. The value of CNST depends on the nozzle exit Mach number (M_c) and the centerline temperature. (See Page A-85).

Stability and Print Criteria

In order to insure stability, the axial step size, Δx, must be kept small. It was found that the system became unstable when the influence parameter

$$cz = \{\Delta x\cdot\varepsilon\cdot u\cdot r^2\cdot p^2\}/\{2\cdot\psi^2\cdot T^2\cdot r^2\} \geq 0.20$$

To achieve a solution in a reasonable length of time, the step size Δx should be as large as possible. Accordingly, czm, the maximum value of cz for each axial location is examined. If czm is too great, Δx is reduced for ensuing calculations. If czm is too small, Δx is increased for ensuing calculations.

Flow parameters are not entered into the data array at every value of Δx calculated. The calculation step sizes are too small. Tabulation occurs whenever the number of Δx increments from the previous calculation exceeds NBS or the sum of the Δx's exceed Δxp. Δxp is incremented after each tabulation such that

$$\Delta xp_N = xp_O \ (0.5N)$$

Excessive static pressure at the nozzle exit plane is treated in a pseudo convergent-divergent nozzle manner which reduces the pressure to ambient value while accelerating and expanding the plume core to supersonic velocity over an axial distance of one nozzle diameter.

The program develops a plume gas data array containing the velocity, pressure, temperature, CO_2 concentration, H_2O concentration, and radius for up to 30 radii over an axial span of 49 stations. The velocity and pressure are multiplexed to share common registers. (See PLMDM for demultiplexing).

PROGRAM: FLINP (Page A-87)

FUNCTION: Provide a vehicle by which the required calculation parameters, nozzle exit flow quantities and data initialization can be read into ASDIR.

INPUT: All control and computational variables in the PLUMIN namelist.

OUTPUT: Computationally compatible engine nozzle exit plane flow quantity data. Nozzle and ambient data are printed.

SUBROUTINES: CHEM, THRUST

DESCRIPTION: The flow diagram of Program FLINP is shown in Figure 7. The function of this program is to initialize engine operational input and control quantities. The control function is derived from the input data. If the engine operational input quantities are not of the proper form, certain operations and additional reads are invoked to put the input into a form compatible with the PLMDEF program. Details can be found in ASDIR-II, Volume I, Users Manual.

In general, if PA is contained in namelist PLUMIN, the Mil Std 210 standard atmosphere in subroutine THRUST is bypassed. The inference is that an off-standard or test facility ambient condition is being simulated and the other ambient quantities are required in PLUMIN. Similarly, this program will bypass the default engine sample case if a nozzle exit velocity U8(1) is given greater than 1 ft per sec or if an ambient velocity UA is given greater than 11 ft per sec. Further, if U8(1) is greater than 1 the volume for T8T, P8, PQ, XCO2, XH2O will be accepted as given in PLUMIN. Again, if XCO2 has been omitted or given a small value (i.e. ≤ XCO2A), the XCO2, XH2O, R, GAMMA, etc. will be calculated in CHEM for the fuel type (TANE) and stoichiometric equivalent ratio (EQR). Finally, if a gas quantity distribution for U8, T8T, XCO2, and XH2O is given in PLUMIN, they will be accepted unchanged since the load array key is taken from a test on U8(2).

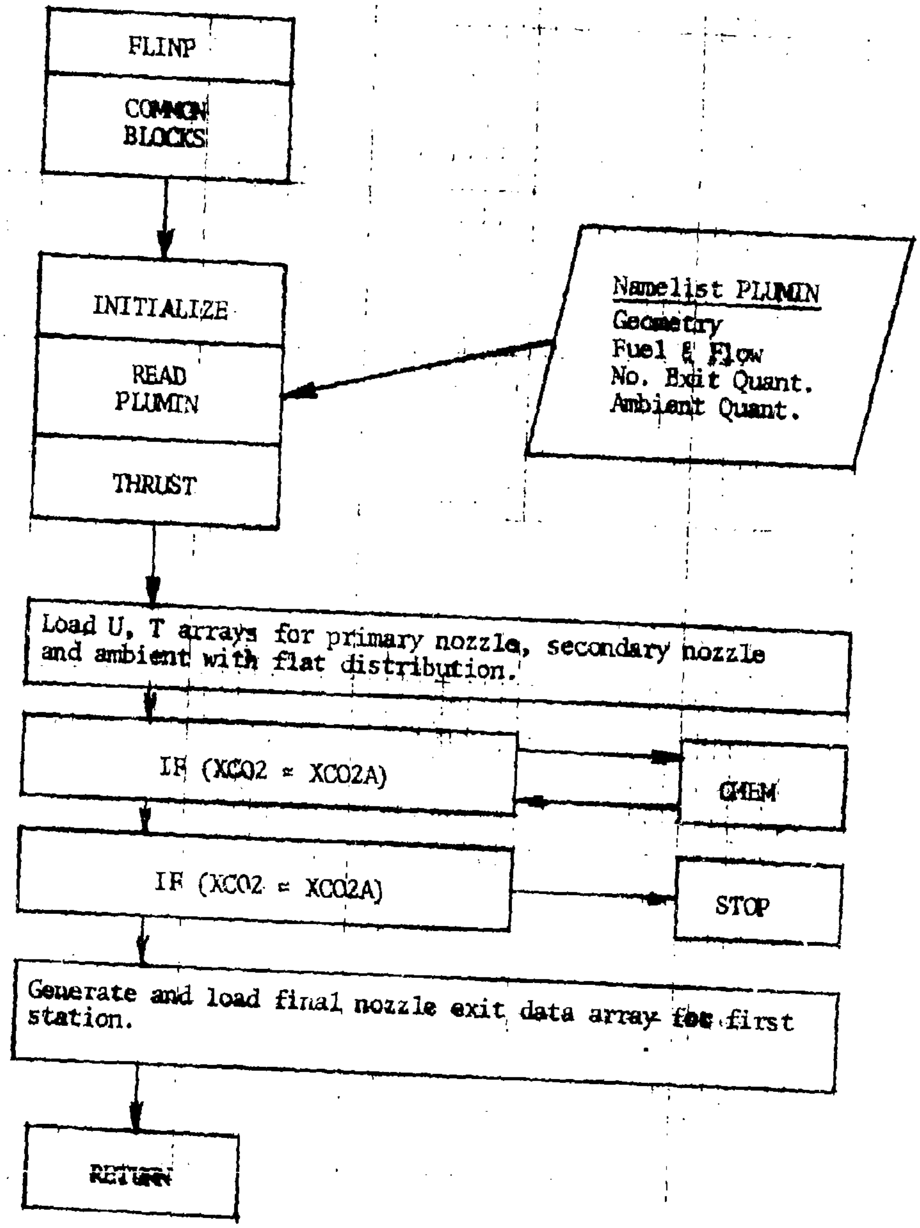


Figure 7. FLINP Flow Diagram

PROGRAM: CHEM (Page A-91)

FUNCTION: Generate the post combustion gas description (gas constant, specific heat and specific heat ratio, molecular weight, species conservation, etc) for a given fuel type, TANE, stoichiometric equivalence ratio, EQR.

INPUT: TANE, EQR

OUTPUT: Fuel to air ratio, gas constant, specific heat, gamma, CO_2 concentration, and H_2O concentration.

SUBROUTINES: None

DESCRIPTION: This program calculates the gas properties for the products of combustion with ideal combustion. Since combustion products properties vary only slightly with pressure and tend to chemically freeze near 2500°F in typical nozzle flow, the precision of this simple college chemistry approach is adequate and the fast calculation makes it a worthwhile approach.

PROGRAM:	THRUST (Page A-93)
FUNCTION:	Provide a vehicle by which the required calculation parameters and engine operating quantities can be read into ASDIR.
INPUT:	All control and computational variables in the POWER namelist.
OUTPUT:	Computationally compatible engine nozzle exit plane flow quantities not provided in FLINP input namelist PLUMIN. Flight condition data is printed.
SUBROUTINES:	CHEM
DESCRIPTION:	The flow diagram of subroutine THRUST is shown in figure 8. The function of this program is to read atmospheric, engine type, data type code, and engine specific performance data. The program control functions described for Program FLINP apply throughout this program.

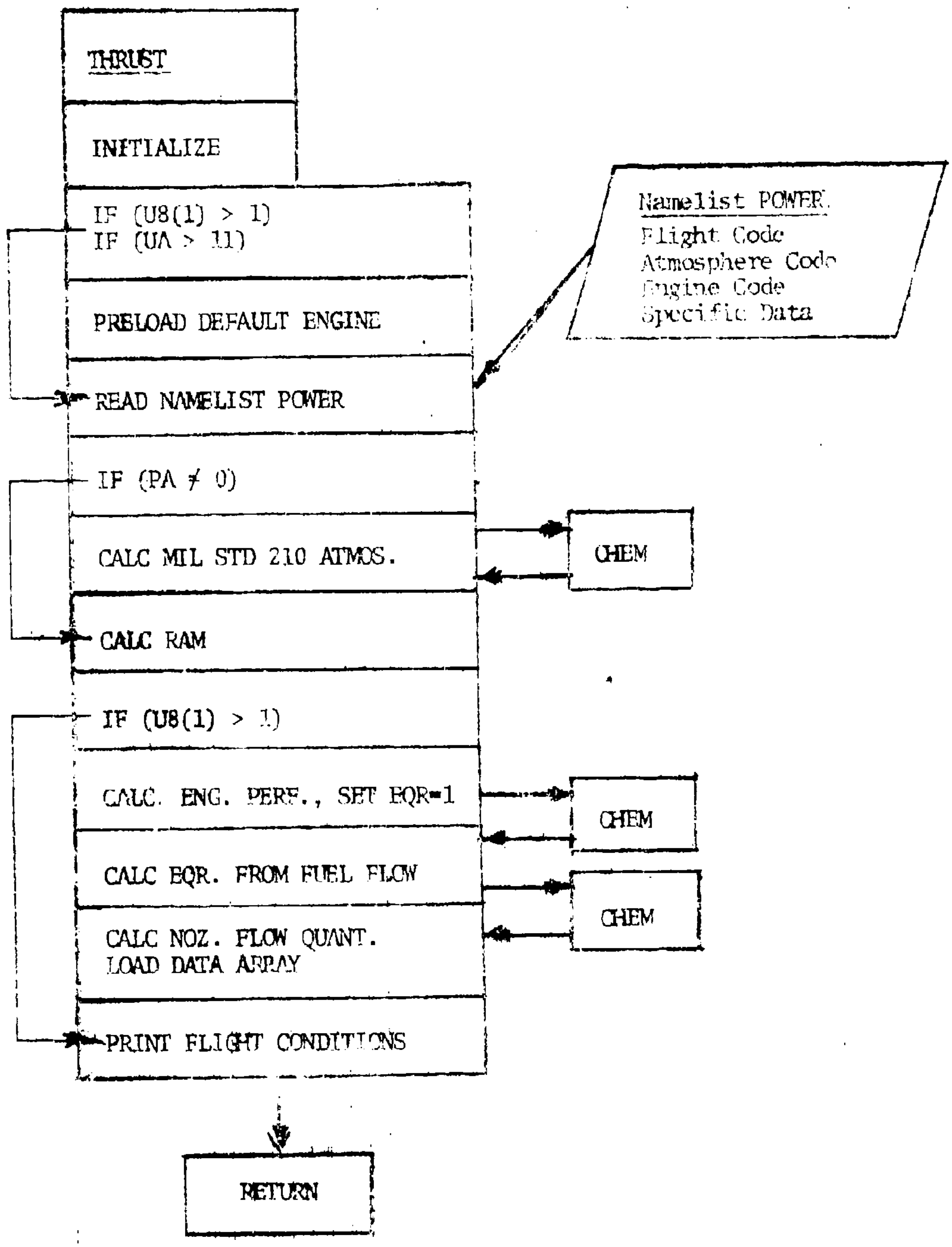


Figure 8. THRUST Flow Diagram

PROGRAM: PLMDM (Page A-98)

FUNCTION: To manage the plume gas data. An input control parameter, KDATA, controls the dispatch of the plume gas data.

INPUT: Plume gas data and the control code KDATA.

OUTPUT: Plume gas data output to cards, tape, printer, or printer plot in any combination.

SUBROUTINES: PLMPLT, PLMPRNT

DESCRIPTION: Each digit of the five digit integer KDATA controls an I/O function. KDATA is represented by the value:

KDATA = A B C D E

If A = 0, a new plume will be calculated. If A = 1*, an old plume previously filed will be brought in and plume calculations will be bypassed. If A > 1, plume gas data will be read from input cards.

If B = 1*, the plume gas data array is filed in the computer for later or repeated analysis. If B ≠ 1, the filing operation is bypassed.

If C = 1*, the plume gas data array is punched into output cards for later or repeated analysis. If C ≠ 1, the punch operation is bypassed.

If D = 1, the plume gas data array is printed in output by subroutine PLMPRNT. If D ≠ 1, the print operation is bypassed.

The subroutine PLMPLT is called with the final value E in the KDATA code. The E value has a different pattern than exhibited by A through D, see PLMPLT.

In addition to breaking down the code carried by KDATA, this program adds a layer of ambient data all around the plume data. The ambient data blanket is necessary to contain the interpolation exercises performed in the ray tracing calculations. The program then searches the plume gas data array to locate the tip of the core and

record such other parameters such as plume length AL, plume diameter REND, plume edge tangent TNB, etc. The minimum output RB, XC, REND, and AL is printed.

The PLMDM flow chart is shown in Figure 9.

*This code represents a machine dependent operation and may require further development for satisfactory operation.

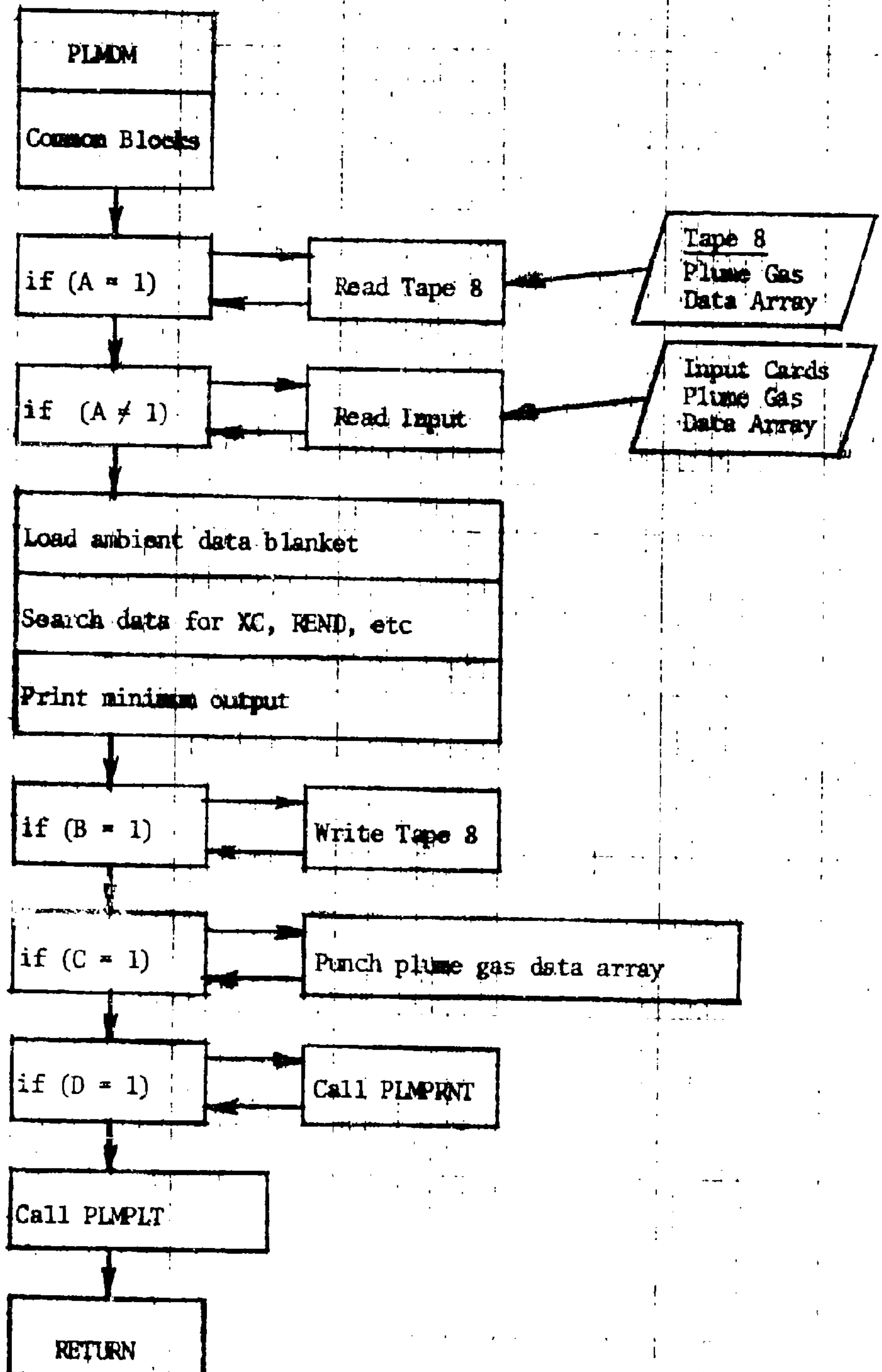


Figure 9. PLMDM Flow Diagram

PROGRAM: PLMPRNT (See Page A-100)

FUNCTION: Print the contents of the plume gas data array on the output printer.

INPUT: The plume gas data array

OUTPUT: The plume gas data

SUBROUTINE: None

DESCRIPTION: Print the plume gas data array. The plume gas data is printed in the following sequence:

- general caption
- plume station number and location
- centerline and edge Mach numbers
- radius, velocity, pressure, temperature, and CO2 and H20 concentration

Units are printed in the captions. The quantities printed are all self explanatory except the edge Mach number. The edge Mach number is that value at the outer edge of the innermost shear plane. This quantity will tend to oscilate due to the stepping and clipping process which occurs in the finite differencing procedure.

PROGRAM:	PLMPLT (See Page A-101)
FUNCTION:	Plot selected plume gas data quantities on the output printer.
INPUT:	The plume gas data array and the final digit of the KDATA control code.
OUTPUT:	Selected arguments of the plume gas data plotted on the output printer.
SUBROUTINES:	None

DESCRIPTION:

The output printer has 136 characters horizontally and more than 60 lines vertically. The grid represented by lines and characters are assigned one of the letters in the word plume (P L U M E) with the addition of # to permit the plotting of six ranges. A space is assigned the first character portion after a change in range. The nozzle exit plane value establishes the separator between # for values greater than the nozzle exit value and P for values between 80% and 100% of the nozzle exit value. Values in the 60% to 80% range are assigned L. Values between 40% and 60% are assigned U, etc. Each line represents a radius, and the interstation distance accumulates a number of characters. With two way interpolation a printer line is compiled and printed. After the data has been plotted, the axial scale is compiled and printed.

The code designating the plume gas data to be plotted is provided by the single digit value remaining in KDATA after having been stripped in program PLMDM. Up to four plots can be generated. In their plotting sequence, they are temperature, XO2 concentration, H20 concentration, and plume velocity. The appropriate captions are included. All four data arguments are plotted if the E value of KDATA is given as 0. If E = 1, no plots are printed. If E = 2, the last three are printed, if E = 3, the last two are printed, if E = 4, the last plot only is printed, and if E is greater than 4, the program will fail. For the general breakdown of KDATA, see program PLMDM.

The final activity accomplished in program PLMPLT is the de-multiplexing of the velocity and pressure. The pressure is brought up from the back of each velocity-pressure register and replaces the velocity. The velocity is no longer retained in the plume gas data array.

PROGRAM: ALPLUM (See Page A-47)

FUNCTION: Calculate total apparent spectral radiance of exhaust plume and hot engine parts as received by an observer with plume and atmospheric emissions and attenuation, including background contributions considered.

INPUT: Flight conditions, engine hot parts and plume parameters.

OUTPUT: Engine/Plume IR Signature

SUBROUTINES: RAYCAL, PLURAY, PLUSIG

DESCRIPTION: The flow diagram of program ALPLUM is shown in figure 10. The prime function of this routine is to be the controlling program to allow calculation of aircraft infrared signatures. Description of the working programs controlled by ALPLUM are contained under the individual program titles.

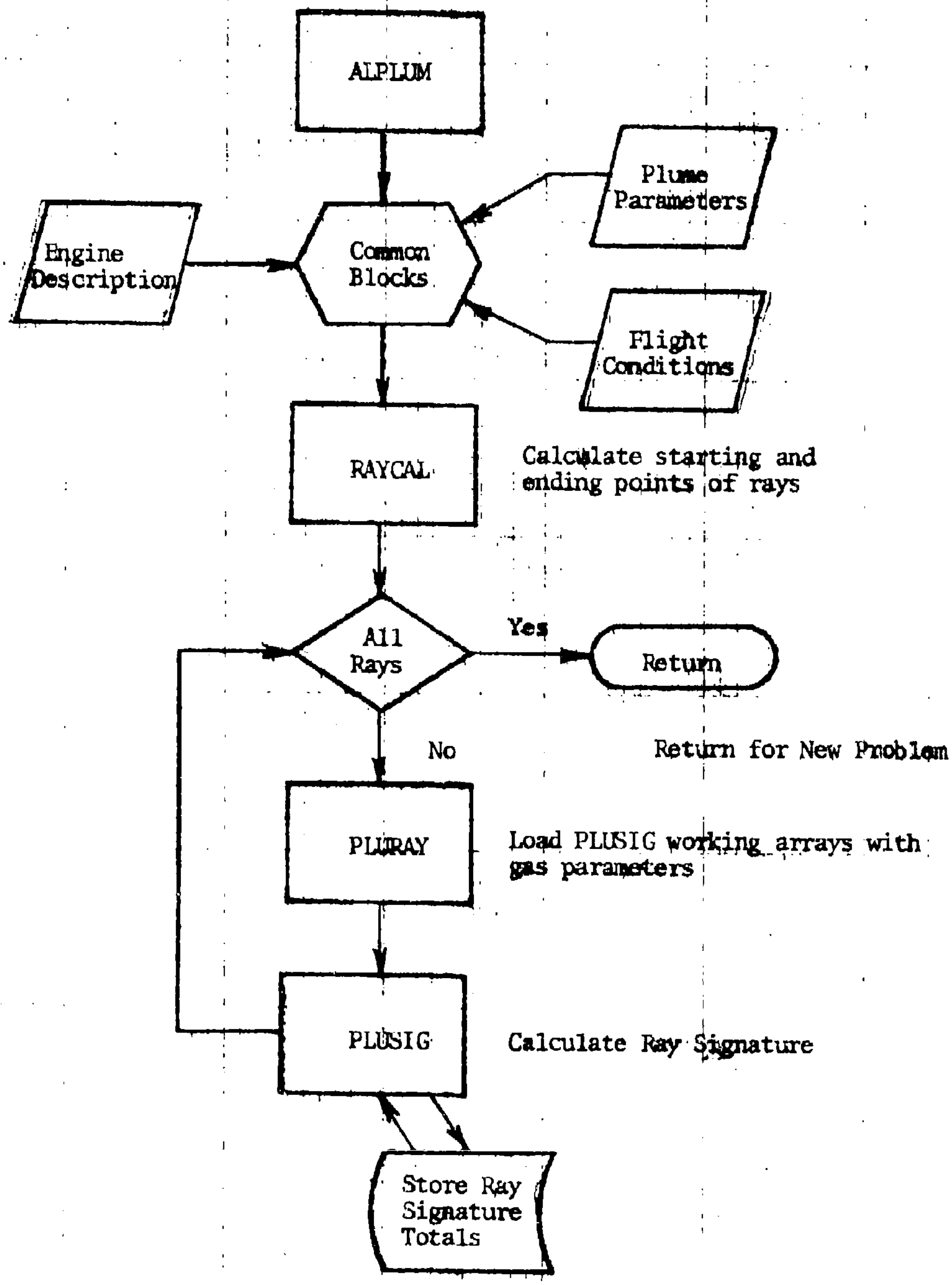


Figure 10. Total IR Signature Calculation

PROGRAM: RAYCAL (Page A-50)

FUNCTION: To segment plume into discrete areas for signature analysis in other routines.

INPUT: Plume and engine geometry.

OUTPUT: Array of plume segment parameters.

SUBROUTINES: None

DESCRIPTION: RAYCAL, being basically geometric, is a relatively simple program. However, since signature prediction accuracy is dependent upon the geometric representation of the engine nozzle and the plume, graphical detail will be presented for this routine.

The engine nozzle and plume are characterized as a series of planar area segments each representing the termination of a ray or beam of radiated energy. Each segment represents either free (background) space or a black surface. The cross-sectional shape and area of each ray is defined by the segmentation scheme and is constant along the ray centerline. The segmentation scheme takes full advantage of symmetry as described with reference to the six accompanying figures.

Rectangular coordinates provide, figure 11, the framework for the ray definition. The X axis represents the engine nozzle centerline. The D axis, in the nozzle exit and perpendicular to the centerline X, is free to rotate about X so that the plane D-X will contain the centerline ray. The lateral axis, Z, is normal to both D and X. The angle of view, known as the aspect angle or ASPDEG, A8, is measured from the centerline X and lies in the D-X plane as shown in figure 12.

> Dimensions on D represent the normal intercept of the ray centerline on plane D-Z from the Z axis.
>
> Dimensions on Z represent the lateral intercept of the ray centerline on plane D-Z from the D axis.
>
> Dimensions on X represent the axial intercept of the ray centerline on plane X-Z from the Z axis.

The simplified plume geometry adopted for use in this program is shown in figure 13. The plume is analyzed in three independent but adjoining regions:

(1) The plume core is segmented in the X-Z plane into a number of radial and angular segments shown in figure 14. Segmentation begins at the extremity of the nozzle exit projection on the X-Z plane and continues to the extremity of the core.

(2) The plume skirt is segmented in the X-Z plane into a number of radial and angular segments shown in figure 15. Segmentation begins at the extremity of the core and continues to the extremity of the plume.

(3) The engine nozzle is segmented in the D-Z plane into a number of radial and angular segments shown in figure 16.

Each planar segment so generated also defines a ray segment. The D-Z or D-X ray segment centerline intercept is centrally located, see asterisks, in each planar segment. Further, each segment is considered to be the ray segments own projection on the D-Z and D-X planes from which the ray segment cross section area, RAR, is calculated.

The ray segments are generated on the first call to RAYCAL. Successive calls simply transfer previously generated data.

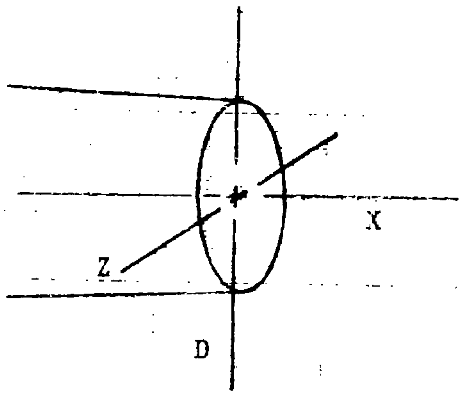


Figure 11. Ray Coordinate System

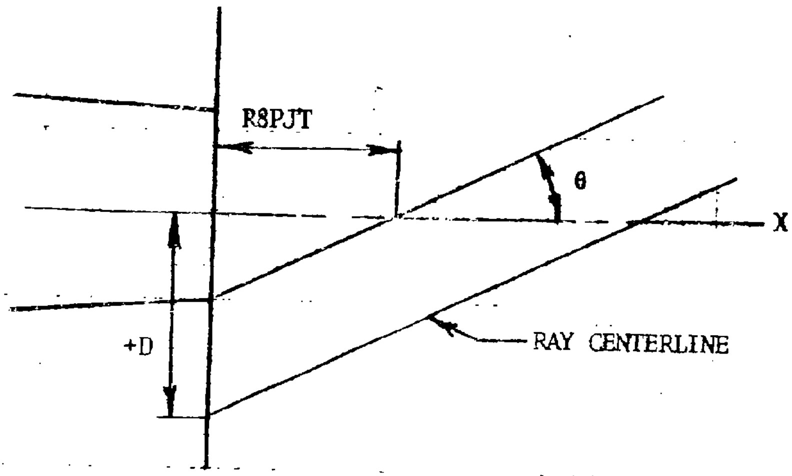


Figure 12. (D, X) Plane

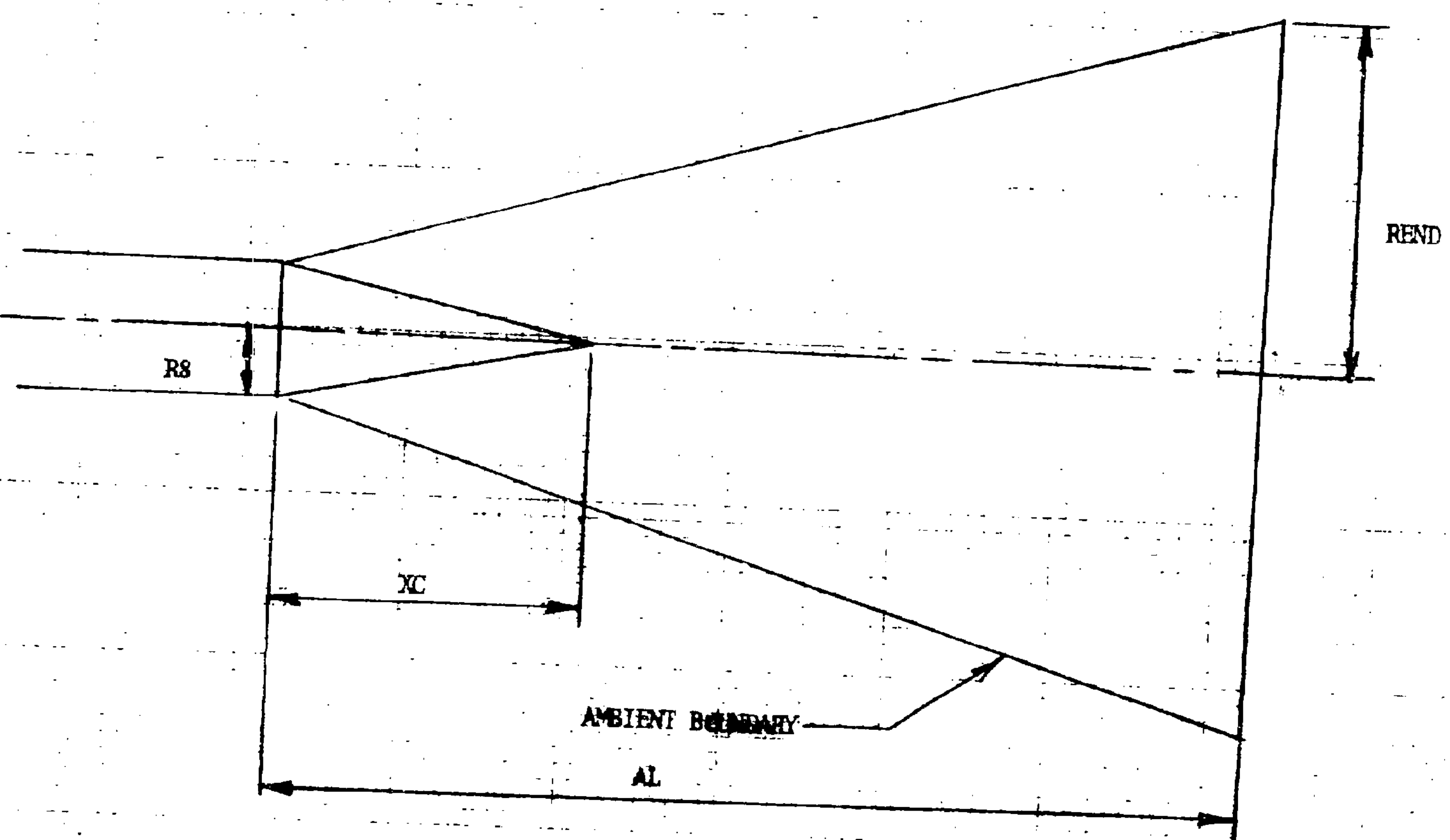
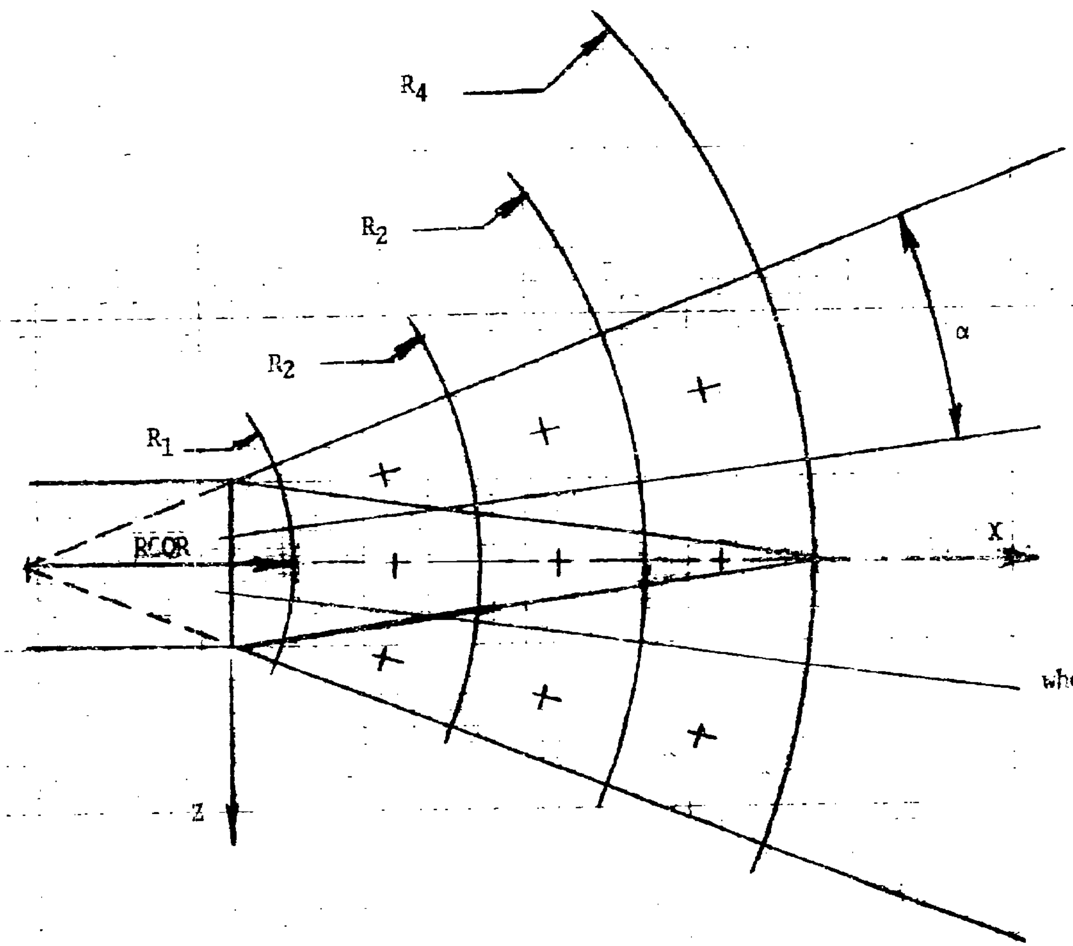


Figure 13. Plume Geometry



$$dR = \frac{XC - R8PJT}{NEXIT}$$

$$R_1 = R8PJT + RCOR$$

$$R_2 = R_1 + dR$$

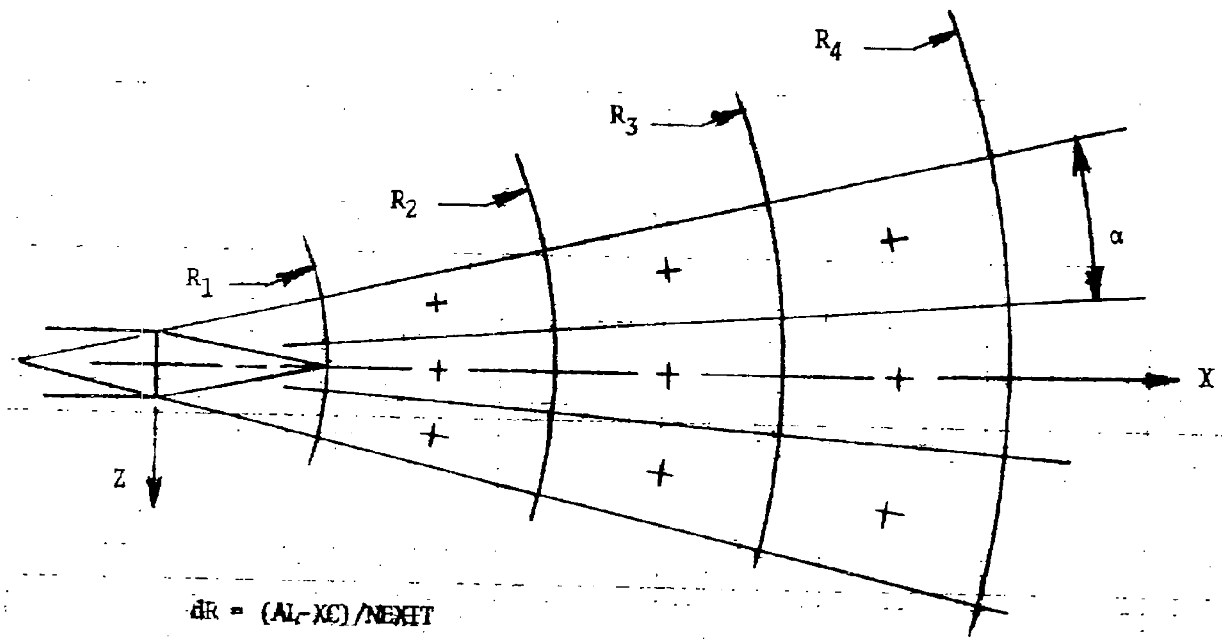
$$R_3 = R_2 + dR$$

$$R_4 = XC + RCOR$$

$$\alpha = 2 \cdot TAN^{-1}(B)/NANGSEG$$

$$\text{where } B = \frac{REND - R8}{AL}$$

Figure 14. Segmentation of Core Region (X, Z) Plume



$dR = (AL - XC)/NEXIT$

$R_1 = XC + RCOR$

$R_2 = R_1 + dR$

$R_3 = R_2 + dR$

$R_4 = AL + RCOR$

Figure 15. Segmentation of Non-Core Region (X, Z) Plume

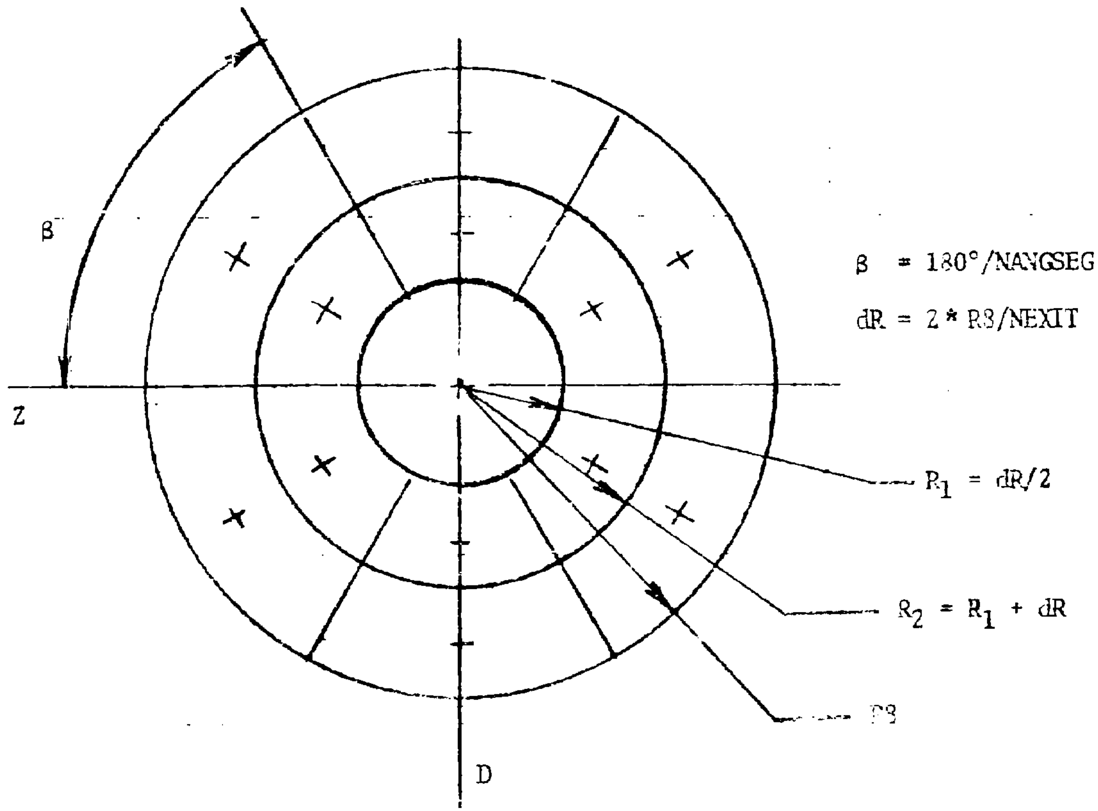


Figure 16. Nozzle Exit Segmentation

PROGRAM:	PLURAY (Page A-54)
FUNCTION:	Generate the parameters describing the ray which are required in the signature analysis routines.
INPUT:	Ray starting geometry, plume gas parameters.
OUTPUT:	Ray geometry, gas partial pressures and gas static temperature arrays.
SUBROUTINES:	INTERP, START
DESCRIPTION:	By referencing the plume gas data and the ray definition parameters, this routine fills the pressure, temperature, and length array with the proper data for ray signature analysis, see figure 17.

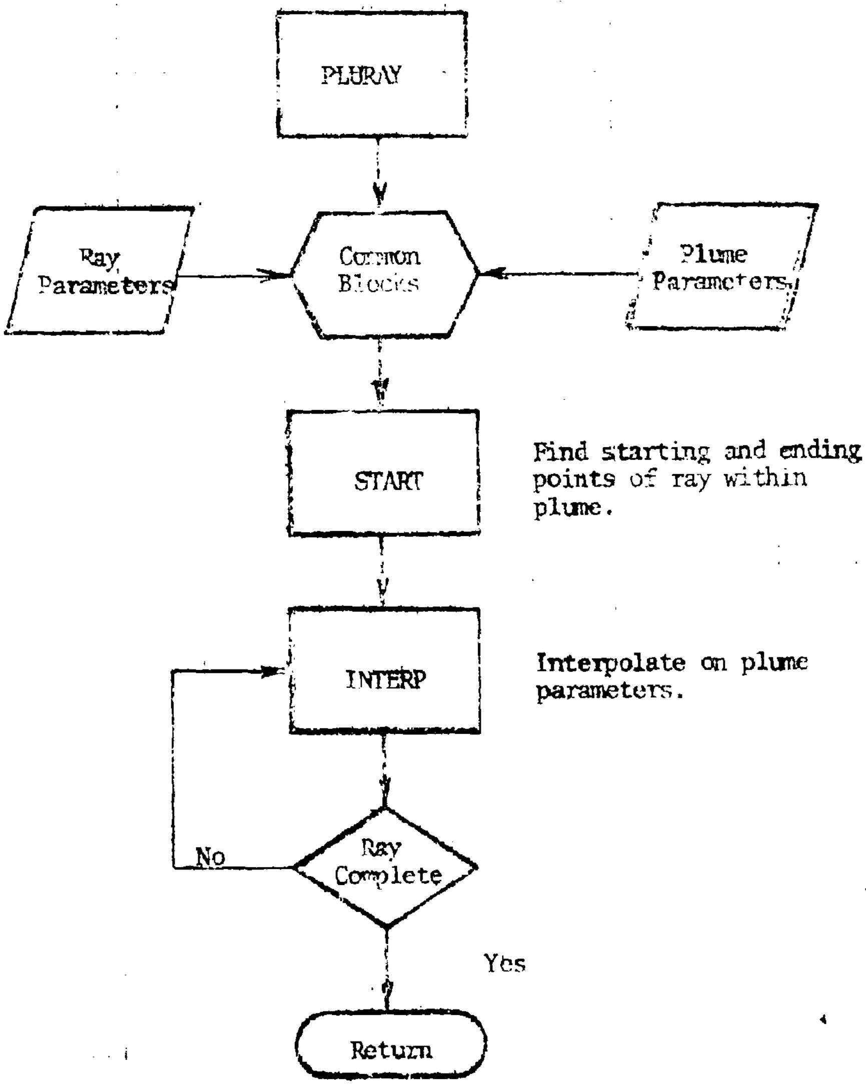


Figure 17. PLURAY Flow Diagram

PROGRAM:	START (Page A-57)
FUNCTION:	To calculate the starting and ending points of a ray through the plume.
INPUT:	Plume geometry, ray intersections
OUTPUT:	Starting and ending dimensions of ray
SUBROUTINES:	None
DESCRIPTION:	The starting and ending points are banded by engine geometry, engine plug geometry and flow field boundaries.

PROGRAM: INTERP (Page A-61)

FUNCTION: Interpolate on gas parameters to find values at a given point w[illegible]hin the plume.

INPUT: Gas parameters and coordinates of point in plume.

OUTPUT: Concentration and temperature at input point.

SUBROUTINES: Non[illegible]

DESCRIPTION: This program interpolates between stations along the centerline of the plume and along the radial dimension of the plume to find the static temperature, mole concentrations of water vapor and carbon dioxide and gas pressure at the input coordinate.

PROGRAM:	PLUSIG (Page A-63)
FUNCTION:	Evaluate the spectral signature and transmittance of a nonuniform gaseous path of NT segments.
INPUT:	Ray properties (temp, pressures and lengths), and frequency interval.
OUTPUT:	Spectral signature of gaseous ray and spectral transmittance of ray.
SUBROUTINES:	ATMOS, KBCAL, PLANCK, INTERPO, SETTAU, TAUCAL, TAUN2O, ERF, DAH2O, DCO2

DESCRIPTION:

The flow diagram for PLUSIG is shown in figure 18. The prime function of this program is to calculate the spectral signatures of nonuniform gas paths with various end conditions. The gaseous ray is divided into NT nonuniform segments with each segment defined by the partial pressures of H_2O (PH_i), CO_2 (PC_i) and broadening gas (PN_i), length (D_i) and static temperature (T_i). A brief discussion of spectral radiators follows:

Continuum radiation is obtained from liquids and solids because the molecules of the substance are in direct contact and exert forces on each other causing all levels of molecular emissions to occur. However, in the case of gas molecules, the intermolecular spacing is large and the free molecular vibrations and rotations result in discrete spectral emissions.

The intensity of these discrete gaseous emissions obeys the PLANCK radiation law as modified by Kirchoff's law. However, the emissivity of the gas is spectrally dependent and radiation is emitted or absorbed only in narrow wavelength intervals called spectral lines. These spectral lines are clustered into tightly spaced sets called bands. The emissivity of the gas is zero outside these bands and dependent upon line spacing and intensity within the bands.

The inhomogeneous gas band-model expressions used in this program were developed at the University of Michigan and are based on the Curtis-Godson approximation. Rather than attempting to fully explain the excellent work performed at the University of Michigan Infrared and Optics Laboratory (now ERIM) in the areas of gaseous emission and absorptions, see references [5, 6, 7, 8, 9, 10].

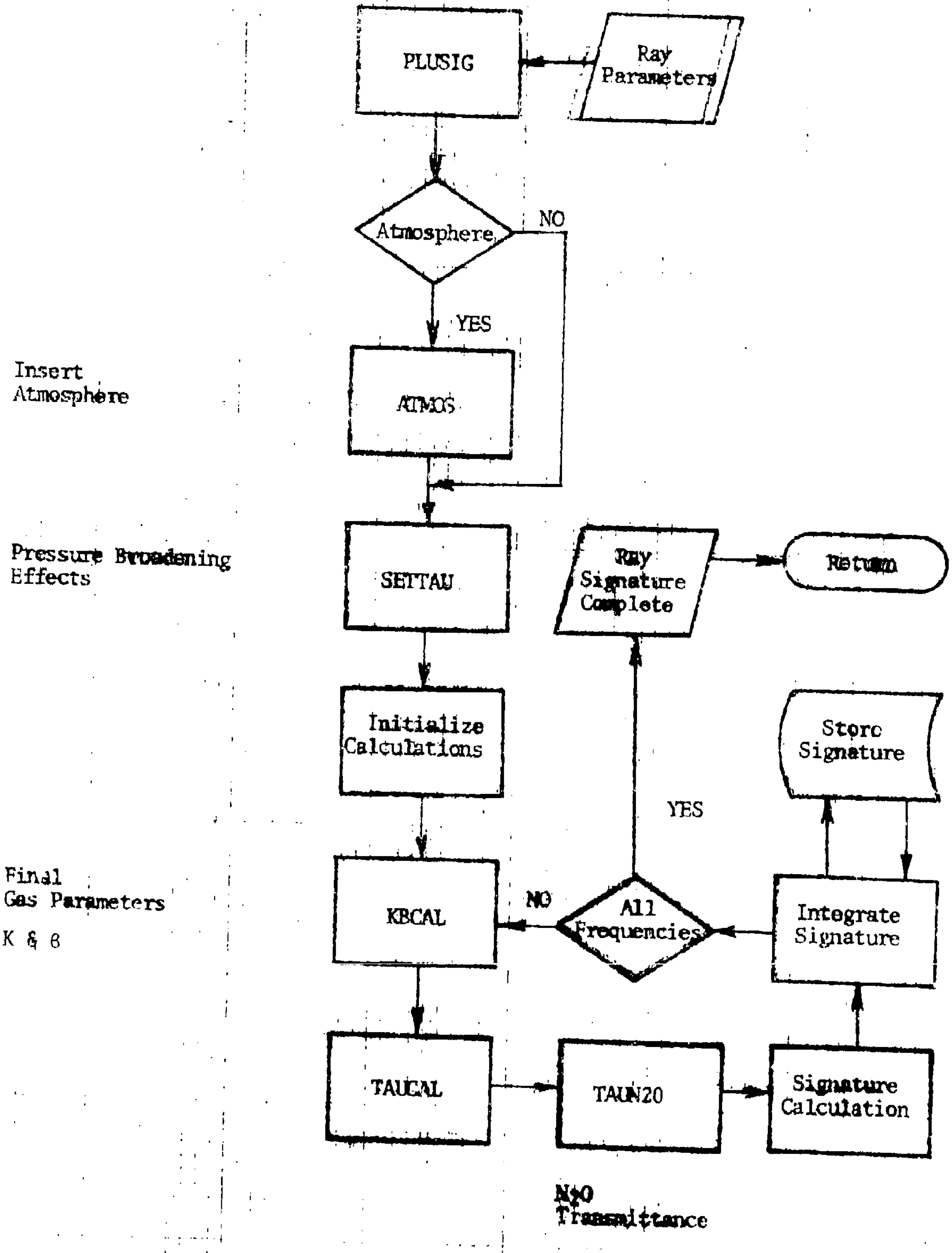


Figure 18. PLUSIG Flow Diagram

A simplified discussion of the function of the program PLUSIG follows: A ray of NT segments, NA of which are atmospheric, of cross sectional area A is entered into the program, figure 19. Each of the NT-NA segments, representing the exhaust plume gas, are described by the gaseous partial pressures, temperatures, and lengths. The atmospheric segments are front loaded in the ray array through the use of the subroutine ATMOS and the range between, and altitudes of the observer and vehicle. The transmissions of each ray segment are calculated in PLUSIG using subroutines KBCAL, INTERPO, SETTAU, TAUCAL, TAUN20, ERF and data contained in Data Blocks DAH20 and DC02.

Figure 19 depicts the information available for a given frequency interval after the exercise of the transmittance calculation subroutines. The signature of the ray is found from

$$L_{e\nu_{ray}} = \sum_{i=1}^{NT} L_{e\nu}(T_i) \cdot \alpha_{\nu i}$$

where $L_{e\nu}$ is the PLANCK function and $\alpha_{\nu i}$ is the absorptance when

$$\alpha_{\nu i} = (1 - \tau_{\nu i}) \cdot \prod_{j=1}^{i} \tau_{\nu j}$$

The total transmittance, τ, for the gaseous path containing NT elements is extractable,

$$\tau_{\nu_{ray}} = \prod_{i=1}^{NT} \tau_{\nu i}$$

Thus the spectral transmittance can be used to determine the plume and atmospheric attenuation of a black surface at the terminus of the ray, figure 20.

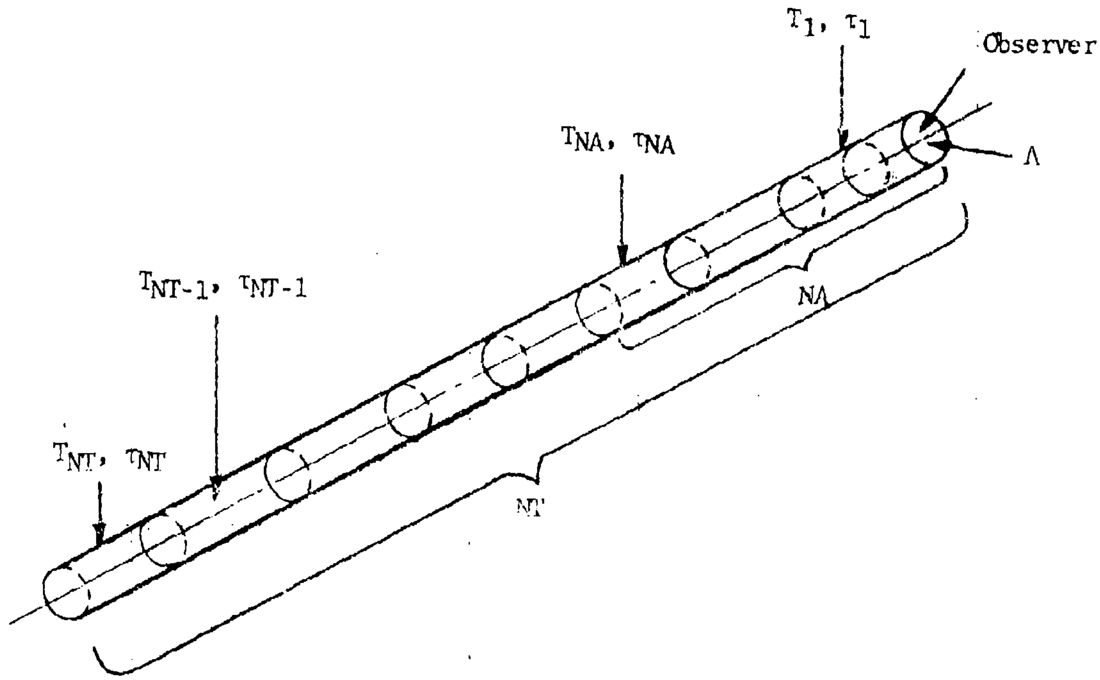


Figure 19. Ray Geometry

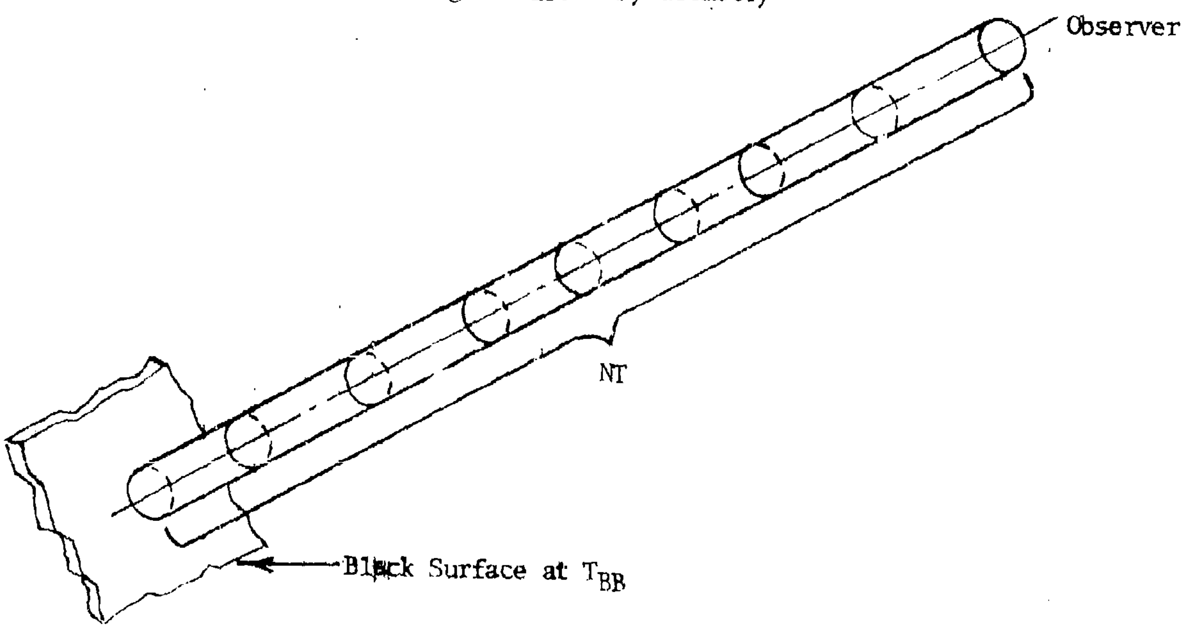


Figure 20. Ray Geometry with Terminating Black Surface

PROGRAM: ATMOS (Page A-69)

FUNCTION: Generate temperatures and partial pressures along an atmospheric path of NA elements and front load the ray pressure and temperature array with the atmospheric data.

INPUT: Range, altitude of plume and observer, number of atmospheric segments

OUTPUT: H_2O, CO_2 and N_2 Pressures

SUBROUTINES: None

DESCRIPTION: Given the geometry of figure 21, the altitude at point r is generated and the temperature and pressures are found from the empirical curve fits used in the computer code. References [8, 11, 12, 13].

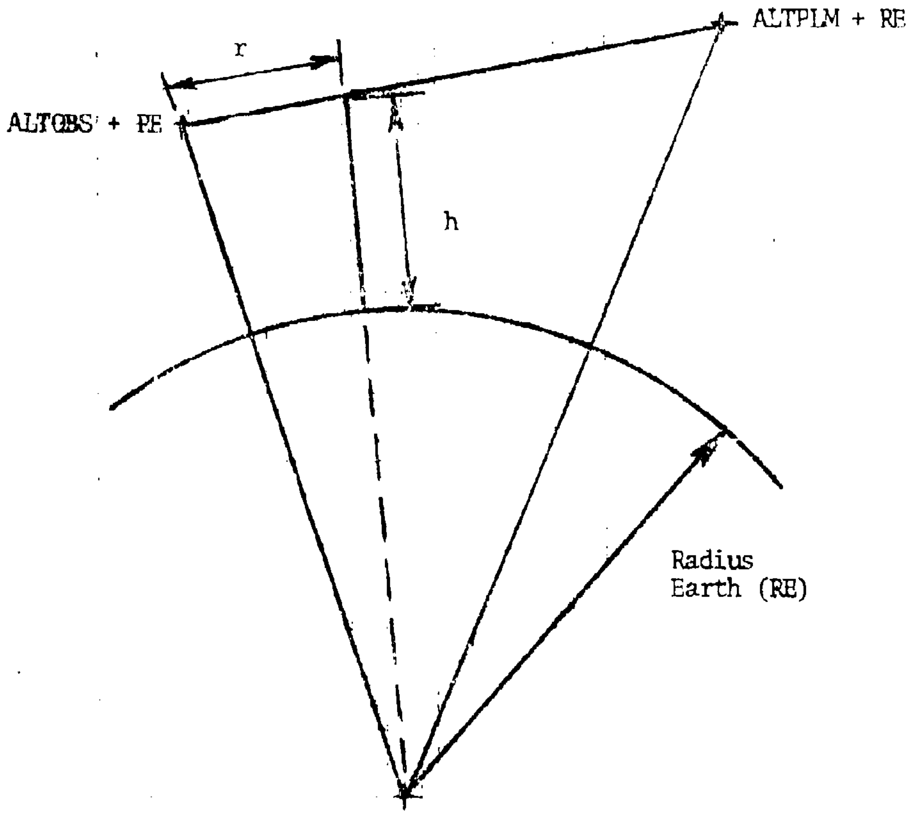


Figure 21. Geometry used in Atmospheric Model

PROGRAM:	SETTAU (Page A-70)
FUNCTION:	Insert pressure broadening effect of broadening gas by modifying effective gas pressures.
INPUT:	H_2O or CO_2 and N_2 gas pressures
OUTPUT:	Modified gas pressures (H_2O-N_2 and CO_2-N_2 mixtures)
SUBROUTINE:	None
DESCRIPTION:	References [6, 7, 8, 9, 10]

PROGRAM: TAUCAL (Page A-71)

FUNCTION: Calculate the gaseous transmittance in a given frequency interval.

INPUT: Pressures, temperatures, gas parameters (K & β)

OUTPUT: Gaseous Transmittances, $\tau(\nu)$

SUBROUTINES: INTERPO

DESCRIPTION: Calculate transmittance of gaseous substance over a given frequency interval using overlapping line approximations.

$$\tau(\nu) = \exp[-\beta_e \cdot f]$$

Where β_e is the effective value of β and f is the Ladenburg-Reiche function. References [6, 10].

PROGRAM: KBCAL (Page A-73)

FUNCTION: To look-up and interpolate on the band model parameters for a given frequency.

INPUT: Frequency, gas type

OUTPUT: K, β, temp and number of temperatures

SUBROUTINES: None

DESCRIPTION: The average line width to spacing ratio multiplied by $1/2\ \pi$ called β, and the average line strength to spacing ratio called K are generated in this subroutine. These parameters are found at a given input frequency for H_2O and CO_2 over the temperature range from 300°K to 3000°K.

PROGRAM: Function PLANCK (Page A-75)

FUNCTION: Calculate PLANCK's blackbody function

INPUT: Frequency (cm^{-1}), temperature (°K).

OUTPUT: Watts/Steradian/cm^3

SUBROUTINES: None

DESCRIPTION: From the classical expression for the radiant emittance into a Lambertian hemisphere

$$M_{e\nu} = \frac{2\pi(\kappa T)^4}{c^2h^3}\left[\frac{x^3}{\exp(x)-1}\right]$$

where

$$x = h\nu/\kappa T$$

the spectral radiant sterance for a given frequency and temperature can be found

$$L_{e\nu} = 2hc^2\nu^3/(\exp(x)-1)$$

See Reference [14].

PROGRAM:	Function INTERPO (Page A-76)
FUNCTION:	Interpolate over the N dimensional set (X, Y) to find the value at a given point (ARG).
INPUT:	X, Y, N, ARG
OUTPUT:	INTERPO
SUBROUTINES:	None
DESCRIPTION:	See Page A-76.

PROGRAM: TAUN2O (Page A-77)

FUNCTION: Calculate transmittance of N_2O in the atmosphere over selected frequency intervals.

INPUT: Frequency, atmospheric N_2O.

OUTPUT: Transmittance of N_2O in atmosphere.

SUBROUTINES: ERF, INTERPO

DESCRIPTION: See Page A-77.

PROGRAM:	Function ERF (Page A-78)
FUNCTION:	To evaluate the error function, erf(x).
INPUT:	X
OUTPUT:	ERF (x)
SUBROUTINES:	None
DESCRIPTION:	Evaluates the error function.

$$\operatorname{erf}(x) = 2/\sqrt{\pi} \int_0^x \exp(-t^2)\,dt$$

References

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3. Parcells, R. F., A. N. Blaser and T. E. Mouritsen, "Aircraft Engine Infrared Signature Prediction Program (SIGNIR-2). USER'S MANUAL", Vought Aeronautics, LTV Aerospace Corporation, TR No. 2-53390/3R-3097, 25 June 1973.

4. Parcells, R. F., A. N. Blaser and T. E. Mouritsen, "Aircraft Engine Infrared Signature Prediction Program (SIGNIR), USER'S MANUAL", Vought Aeronautics, LTV Aerospace Corporation, TR No. R2-53390/1R-2947, 30 Sept 1971.

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6. Lindquist, G., "How to Use FS + TAUS", University of Michigan, MEMO, 28 Jan 1970 (see ASDIR-II, Volume III, Reference Documentation).

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14. Handbook of Military Infrared Technology, Office of Naval Research, Dept. of the Navy, 1965.

APPENDIX

ASDIR-II

PROGRAM LISTING

APPENDIX

This appendix contains a listing of the Aeronautical Systems Division's Infrared Signature Predicting Model (ASDIR). The computer code was developed in the structural form shown in figure 22. The overlays are organized in three major functional groupings with a fourth overlay dedicated to data initialization. The prime functions of each overlay are:

Overlay	
(0,0)	Program Control
(1,0)	Data Input & Initialization
(2,0)	Plume Signature Calculations
(3,0)	Data Initialization
(4,0)	Plume Gas Dynamics
(5,0)	Plume Data I/O
(6,0)	Spectral Filter Data Initialization
(7,0)	Spatial Output
(11,0)	Hot Parts Temperature Calculation
(12,0)	View Factor Calculations
(13,0)	Hot Part Radiation Calculations
(14,0)	Hot Part Data Control

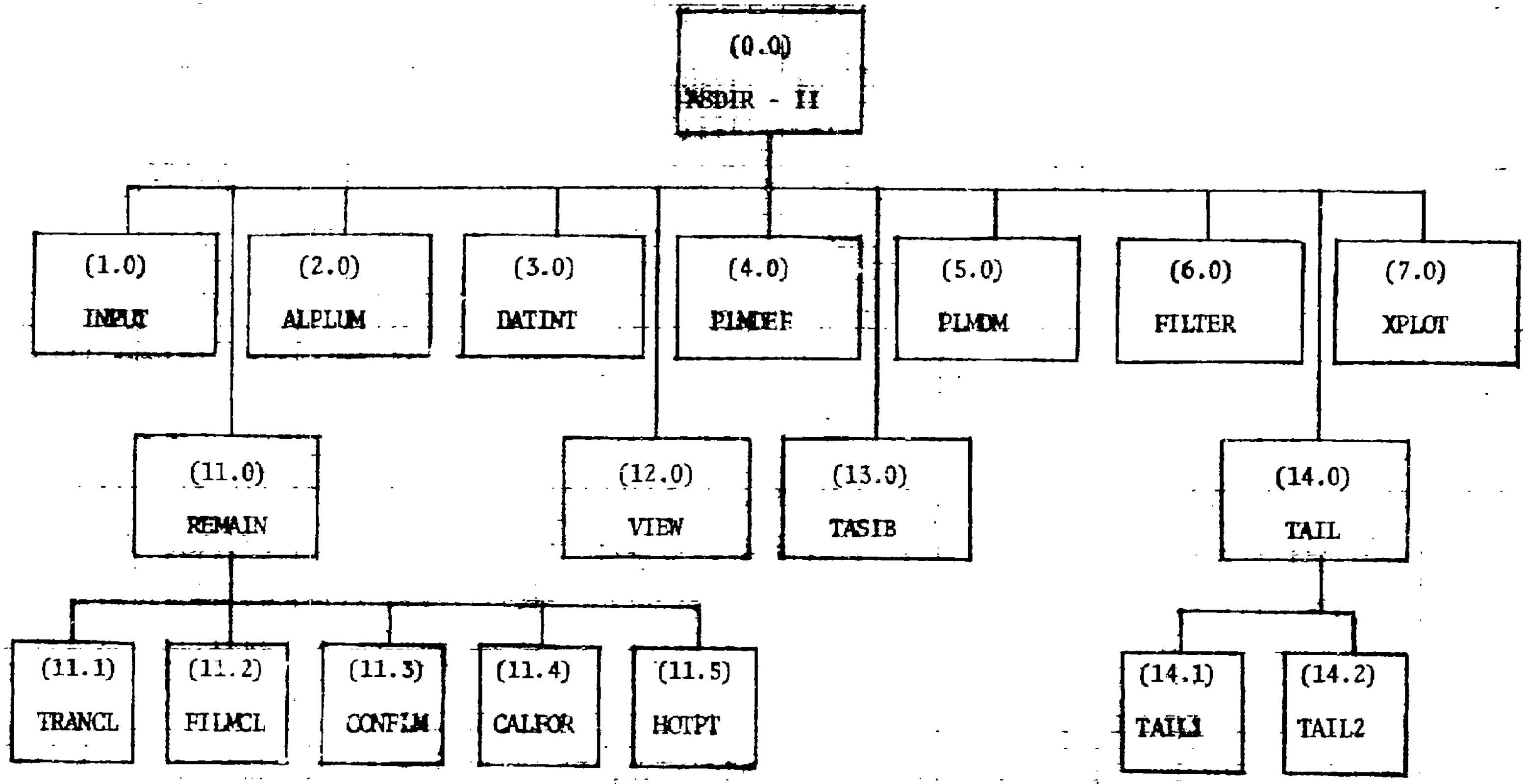

Figure 22. ASDIR-II Overlay Structure

```
      OVERLAY(XRHP,0,0)
      PROGRAM ASDIR2(INPUT,OUTPUT,PUNCH,TAPE2,TAPE4,
     1   TAPE6=TAPE4,TAPE5=INPUT,TAPE6=OUTPUT)
*  *   *  ASDIR2     *     *     *
C           PLUME COMPUTATION
      COMMON/LINK2/ A1,H0,HD2
      COMMON/LINK3/ H1,H2,A0,IMS
*  GEO
      COMMON /GEO/
     1   AS,        AL,       B8,       DDS,       NEN,       NP,
     2   RC,        RDD,      RBZ,      REN(10),   RF,        RO,
     3   RDZ,       RP,       RPZ,      SC,        SS,        TANA,
     4   THB,       TANP,     XC,       XEN(10),   XF,        XO,
     5   XP,        RENO
*  INP
      COMMON /INP/
     1 D,  DDZ,  DX,  DTST,  DZ,  NDZ,  NOP,  RAYPNT,  ZTST
*  PLM
      COMMON/PLM/PLMOD(43),RCN,ST(50),KRO(50),PLM(5,30,50),NFLM,PA,P6,
     1   CHK,KDATA,ISHK,JSHK,TAKE,EQR
      DIMENSION XY(50)
      EQUIVALENCE (NOFLOW,NFLM),(XY(1),ST(1))
*  ATMOS
      COMMON/ATMOS/ALT,FLTH,METEC,PREC,RAMF,RAMT,DELT2,THET2
*  OBST
      COMMON /OBST/ HL(10), HU(10),
     1   NRG,       TA3(5),    TA4(5),   TCB(5),    AMI(5), AME(5)
     2,  NO,        KO
     *,         KI(5),KE(5),DI(5),DE(5),WI(5),WE(5)
*  RAY
      COMMON/RAY/
     1  ADS,  ATST,  A2A,  DO,  DS,  L1
C
*  BETAK,BETAK1
      COMMON/BETAK/ARK(2030)
      COMMON/BETAK1/COEF(7,678)
C
      COMMON/HALT/ITYPE,ITAU,IL,ZZ,ABB(5)
      COMMON/ATMO/NATMO,NRANG,ASPDEG
      COMMON/STAN/ALTOBS(5),ALTPLM,XRANGE(5),IATMO,TBACK(5),TBACKC
      COMMON/SPATIAL/ISPAT
      COMMON/CHUCK/SY(3),NU(300),NUFRST,NUINC,ONU(300)
      COMMON/EXTEMS/EAREA(20),ETEMP(20),NEXT,XCC,SCXT(5,1)
      COMMON/FILTR/IFILTER,BFILTR(300)
      COMMON/GAS/IRADCK
      COMMON /OUT/ AX(20), ATX(20), AAB(20), NAPG,  IHOT
      COMMON /ICHEK/ ICHECK
      CALL OVERLAY(4HXRHP,3,0)
C     CALL DATINES
      CALL SIGNIR
      DO 260 IZ=1,7644
  260 PLMOD(IZ)=0.
  270 CONTINUE
      CALL OVERLAY(4HXRHP,1,0)
C     CALL INPUTS
      IF(IRADCK.LE.0) GO TO 271
      CALL OVERLAY(4HXRHP,2,0)
```

```
C     CALL ALPLUMS
      GO TO 270
  271 CONTINUE
      IF(NOFLOW.EQ.1) GO TO 100
      IF(IFILTER.NE.0) CALL OVERLAY(4HXRMP,6,0)
C     IF(IFILTER.NE.0) CALL FILTER
C
C   FLOW FIELD IN MAIN REGION
C
      IREAD=YDATA/10000+4400
      IF(IREAD.EQ.4400) WRITE(6,4400)
      IF(IREAD.EQ.4401) WRITE(6,4401)
      IF(IREAD.EQ.4402) WRITE(6,4402)
 4400 FORMAT(//33H** PLUME DATA IS CALCULATED.   **)
 4401 FORMAT(//33H** PLUME DATA READ FROM INPUT. **)
 4402 FORMAT(//33H** PLUME DATA READ FROM *PF.   **)
      IF(IREAD.NE.4400) GO TO 15
      CALL OVERLAY(4HXRMP,4,0)
C     CALL PLMDEFS
      IF(IREAD.EQ.4400) GO TO 15
      READ(8)
      WRITE(8)
   15 CONTINUE
      CALL OVERLAY(4HXRMP,5,0)
C     CALL PLMDMS
      DPDX=(PA-P8)/(2.*R8)
      REN(NEN+1)=REN(10)
      XEN(NEN+1)=0.0
      ZTST=REND
C
C   INITIALIZE CALCULATION PARAMETERS
C
      AL=AMI(2)
      IF(AL.GT.XY(49)) AL=XY(49)
      REND=TNB*AL+R8
      IF(A8.EQ.180.) DTST =ZTST
      BDS=DDS
      ZN=NDZ-1
      NOFLOW=1
  100 CONTINUE
      A=A8*0.0174532926
 1060 SC=COS(A)
      SS=SIN(A)
      IF(A8.EQ.90..OR.A8.EQ.0.) GO TO 200
      TANA=SS/SC
      DTST=AL*TANA
      D=XY(49)/SC
      IF(D.LT.DTST) DTST=D
  200 CONTINUE
      DDZ=38/ZN
      IF(DDZ.EQ.0.) GO TO 1064
      ND=NDZ/2
      ADS=BDS
      CALL OVERLAY(4HXRMP,2,0)
C     CALL ALPLUMS
```

```
115            IF(ISPAT.LE.0) GO TO 270                                 ASDIR2$   116
               CALL OVERLAY(4HXRAP,7,0)                                 ASDIR2$   117
          C    CALL XPLOT                                               ASDIR2$   118
           1004 GO TO 270                                               ASDIR2$   119
               END                                                      ASDIR2$   120
```

```
      BLOCK DATA CO2                                                    DCO2       2
      COMMON/BETAK/KCO2(7,176),BCO2(7,114)                              DCO2       3
      REAL KCO2                                                         DCO2       4
       DATA (BCO2(1,J),J= 1, 60)/                                       DCO2       5
     * 0.        , 0.        , .1376E+01, .1376E+01, .1376E+01,         DCO2       6
     *  .1376E+01, .1376E+01, .1376E+01, .1376E+01, .1376E+01,          DCO2       7
     *  .1376E+01, .1376E+01, .1376E+01, .1376E+01, .1376E+01,          DCO2       8
     *  .1376E+01, .1376E+01, .1376E+01, .1376E+01, .1376E+01,          DCO2       9
     *  .1376E+01, .1376E+01, .1376E+01, .1376E+01, .1376E+01,          DCO2      10
     *  .1376E+01, .1376E+01, .1376E+01, .1376E+01, .1376E+01,          DCO2      11
     *  .1331E+01, .1285E+01, .1236E+01, .1030E+01, .8238E+00,          DCO2      12
     *  .6486E+00, .6281E+00, .1536E+01, .7079E+00, .5877E+00,          DCO2      13
     *  .5925E+00, .7872E+00, 0.        , 0.        , .6605E+00,        DCO2      14
     *  .6605E+00, .6605E+00, .6605E+00, .6605E+00, .6605E+00,          DCO2      15
     *  .6605E+00, .6605E+00, .6605E+00, .6605E+00, .6605E+00,          DCO2      16
     *  .6605E+00, .6605E+00, .6605E+00, .6605E+00, .6605E+00/          DCO2      17
       DATA (BCO2(1,J),J=61,114)/                                       DCO2      18
     *  .6605E+00, .6605E+00, .6605E+00, .6653E+00, .6669E+00,          DCO2      19
     *  .6596E+00, .6761E+00, .6947E+00, .6928E+00, .7009E+00,          DCO2      20
     *  .7246E+00, .7387E+00, .7570E+00, .7753E+00, .7937E+00,          DCO2      21
     *  .8120E+00, .8395E+00, .8670E+00, .8966E+00, .9361E+00,          DCO2      22
     *  .9727E+00, .1009E+01, .1055E+01, .1101E+01, .1157E+01,          DCO2      23
     *  .1221E+01, .1294E+01, .1376E+01, .1486E+01, .1652E+01,          DCO2      24
     *  .1737E+01, .1563E+01, .1358E+01, .1138E+01, .9177E+00,          DCO2      25
     *  .7029E+00, .5769E+00, .4533E+00, .4121E+00, .4018E+00,          DCO2      26
     *  .8238E+00, .9166E+00, .8341E+00, .4379E+00, .4482E+00,          DCO2      27
     *  .5101E+00, .5974E+00, .7136E+00, .8497E+00, .1123E+01,          DCO2      28
     *  .1597E+01, .1963E+01, .2048E+01, .1536E+01/                     DCO2      29
       DATA (BCO2(2,J),J= 1, 60)/                                       DCO2      30
     * 0.        , 0.        , .5524E+01, .5524E+01, .5524E+01,        DCO2      31
     *  .5524E+01, .5524E+01, .5524E+01, .5524E+01, .5524E+01,          DCO2      32
     *  .5524E+01, .5524E+01, .5524E+01, .5524E+01, .5524E+01,          DCO2      33
     *  .5524E+01, .5524E+01, .5524E+01, .5524E+01, .5524E+01,          DCO2      34
     *  .5524E+01, .5524E+01, .5524E+01, .5452E+01, .5425E+01,          DCO2      35
     *  .5379E+01, .5307E+01, .5234E+01, .5059E+01, .4723E+01,          DCO2      36
     *  .4216E+01, .3418E+01, .2983E+01, .2486E+01, .2188E+01,          DCO2      37
     *  .2188E+01, .2784E+01, .3052E+01, .1761E+01, .9199E+00,          DCO2      38
     *  .6721E+00, .5615E+00, 0.        , 0.        , .2763E+01,        DCO2      39
     *  .2763E+01, .2763E+01, .2763E+01, .2763E+01, .2763E+01,          DCO2      40
     *  .2763E+01, .2763E+01, .2778E+01, .2778E+01, .2793E+01,          DCO2      41
     *  .2793E+01, .2807E+01, .2807E+01, .2822E+01, .2836E+01/          DCO2      42
       DATA (BCO2(2,J),J=61,114)/                                       DCO2      43
     *  .2851E+01, .2865E+01, .2894E+01, .2923E+01, .2938E+01,          DCO2      44
     *  .2982E+01, .3025E+01, .3084E+01, .3127E+01, .3200E+01,          DCO2      45
     *  .3258E+01, .3345E+01, .3447E+01, .3593E+01, .3738E+01,          DCO2      46
     *  .3896E+01, .4072E+01, .4304E+01, .4552E+01, .4827E+01,          DCO2      47
     *  .5162E+01, .5524E+01, .5890E+01, .6355E+01, .6763E+01,          DCO2      48
     *  .6605E+01, .6615E+01, .6252E+01, .5819E+01, .5235E+01,          DCO2      49
     *  .4579E+01, .3927E+01, .3273E+01, .2676E+01, .1847E+01,          DCO2      50
     *  .1910E+01, .1392E+01, .1074E+01, .6962E+00, .5368E+00,          DCO2      51
     *  .7957E+00, .2188E+01, .2785E+01, .2606E+01, .2387E+01,          DCO2      52
     *  .2287E+01, .2387E+01, .2586E+01, .2884E+01, .3183E+01,          DCO2      53
     *  .3421E+01, .2113E+01, .1960E+01, .1761E+01/                     DCO2      54
       DATA (BCO2(3,J),J= 1, 60)/                                       DCO2      55
     * 0.        , 0.        , .4971E+02, .4971E+02, .4971E+02,        DCO2      56
     *  .4971E+02, .4971E+02, .4971E+02, .4971E+02, .4971E+02,          DCO2      57
     *  .4971E+02, .4971E+02, .4971E+02, .4971E+02, .4971E+02,          DCO2      58
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     * .4971E+02, .4971E+02, .4971E+02, .4877E+02, .4753E+02,          DC02   59
     * .4656E+02, .4534E+02, .4348E+02, .4180E+02, .3820E+02,          DC02   60
     * .3510E+02, .3138E+02, .2825E+02, .2486E+02, .2175E+02,          DC02   61
     * .1864E+02, .1585E+02, .2277E+02, .1750E+02, .1250E+02,          DC02   62
     * .9996E+01, .9441E+01, .6327E+01, .4356E+01, .2076E+01,          DC02   63
     * .9150E+00, .3950E+00, 0.       , 0.       , .4098E+02,          DC02   64
     * .4098E+02, .4098E+02, .4098E+02, .4098E+02, .4098E+02,          DC02   65
     * .4098E+02, .4094E+02, .4150E+02, .4175E+02, .4201E+02,          DC02   66
     * .4252E+02, .4354E+02, .4456E+02, .4556E+02, .4760E+02/          DC02   67
      DATA (BC02(3,J),J=51,114)/                                       DC02   68
     * .4969E+02, .5222E+02, .5482E+02, .5734E+02, .6345E+02,          DC02   69
     * .6454E+02, .6809E+02, .7325E+02, .7836E+02, .8491E+02,          DC02   70
     * .8750E+02, .9216E+02, .9374E+02, .9527E+02, .9783E+02,          DC02   71
     * .9836E+02, .9729E+02, .9272E+02, .8707E+02, .7839E+02,          DC02   72
     * .7318E+02, .5147E+02, .5378E+02, .4760E+02, .4150E+02,          DC02   73
     * .3566E+02, .3125E+02, .2766E+02, .2406E+02, .2152E+02,          DC02   74
     * .1945E+02, .1793E+02, .1690E+02, .1818E+02, .1767E+02,          DC02   75
     * .2244E+02, .1923E+02, .2289E+02, .2930E+02, .3342E+02,          DC02   76
     * .3517E+02, .3846E+02, .4344E+02, .3571E+02, .3434E+02,          DC02   77
     * .3703E+02, .3938E+02, .3754E+02, .3483E+02, .3205E+02,          DC02   78
     * .3022E+02, .1811E+02, .7823E+01, .4725E+01/                     DC02   79
      DATA (BC02(4,J),J= 1, 60)/                                       DC02   80
     * 0.       , 0.       , .9664E+02, .9664E+02, .9664E+02,          DC02   81
     * .9664E+02, .9664E+02, .9664E+02, .9664E+02, .9664E+02,          DC02   82
     * .9664E+02, .9664E+02, .9664E+02, .9664E+02, .9664E+02,          DC02   83
     * .9664E+02, .9664E+02, .9664E+02, .9582E+02, .9455E+02,          DC02   84
     * .9329E+02, .9035E+02, .8531E+02, .7659E+02, .6723E+02,          DC02   85
     * .5674E+02, .4743E+02, .4203E+02, .3781E+02, .3530E+02,          DC02   86
     * .3236E+02, .2614E+02, .2631E+02, .2261E+02, .1973E+02,          DC02   87
     * .1562E+02, .1233E+02, .8221E+01, .4864E+01, .2767E+01,          DC02   88
     * .5150E+00, .3045E+00, 0.       , 0.       , .5883E+02,          DC02   89
     * .5883E+02, .5883E+02, .5883E+02, .5883E+02, .5883E+02,          DC02   90
     * .5883E+02, .5883E+02, .5883E+02, .6141E+02, .5968E+02,          DC02   91
     * .6093E+02, .6178E+02, .6303E+02, .6428E+02, .6638E+02/          DC02   92
      DATA (BC02(4,J),J=51,114)/                                       DC02   93
     * .6976E+02, .7395E+02, .7815E+02, .8405E+02, .8909E+02,          DC02   94
     * .9562E+02, .1030E+03, .1122E+03, .1227E+03, .1345E+03,          DC02   95
     * .1462E+03, .1597E+03, .1744E+03, .1891E+03, .1912E+03,          DC02   96
     * .1525E+03, .1681E+03, .1471E+03, .1261E+03, .1051E+03,          DC02   97
     * .8406E+02, .6850E+02, .5589E+02, .4622E+02, .3824E+02,          DC02   98
     * .3192E+02, .2773E+02, .2396E+02, .2143E+02, .1891E+02,          DC02   99
     * .1723E+02, .1555E+02, .1471E+02, .1408E+02, .1387E+02,          DC02  100
     * .2672E+02, .2631E+02, .2754E+02, .3535E+02, .5343E+02,          DC02  101
     * .6657E+02, .6906E+02, .6824E+02, .6657E+02, .6329E+02,          DC02  102
     * .5917E+02, .5507E+02, .5013E+02, .4603E+02, .4191E+02,          DC02  103
     * .3781E+02, .9973E+01, .9001E+01, .7904E+01/                     DC02  104
      DATA (BC02(5,J),J= 1, 60)/                                       DC02  105
     * 0.       , 0.       , .1921E+03, .1921E+03, .1921E+03,          DC02  106
     * .1921E+03, .1921E+03, .1921E+03, .1921E+03, .1921E+03,          DC02  107
     * .1921E+03, .1921E+03, .1894E+03, .1877E+03, .1839E+03,          DC02  108
     * .1784E+03, .1712E+03, .1646E+03, .1553E+03, .1471E+03,          DC02  109
     * .1388E+03, .1306E+03, .1208E+03, .1098E+03, .9496E+02,          DC02  110
     * .8232E+02, .7134E+02, .6146E+02, .5487E+02, .4884E+02,          DC02  111
     * .4361E+02, .3183E+02, .4845E+02, .2883E+02, .1962E+02,          DC02  112
     * .1530E+02, .1385E+02, .8150E+01, .4972E+01, .2339E+01,          DC02  113
     * .7306E+00, .3319E+00, 0.       , 0.       , .1372E+03,          DC02  114
     * .1372E+03, .1372E+03, .1372E+03, .1372E+03, .1372E+03,          DC02  115
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     * .1372E+03, .1372E+03, .1372E+03, .1372E+03, .1372E+03,         DCO2 116
     * .1383E+03, .1416E+03, .1449E+03, .1493E+03, .1564E+03/         DCO2 117
      DATA (BCO2(5,J),J=61,114)/                                      DCO2 118
     * .1646E+03, .1756E+03, .1894E+03, .2058E+03, .2250E+03,         DCO2 119
     * .2470E+03, .2908E+03, .3896E+03, .4939E+03, .5212E+03,         DCO2 120
     * .5377E+03, .5487E+03, .5708E+03, .5873E+03, .6201E+03,         DCO2 121
     * .6476E+03, .6586E+03, .6038E+03, .3841E+03, .2415E+03,         DCO2 122
     * .1729E+03, .1290E+03, .9549E+02, .7299E+02, .5763E+02,         DCO2 123
     * .4664E+02, .3951E+02, .3511E+02, .3018E+02, .2580E+02,         DCO2 124
     * .2360E+02, .2141E+02, .2003E+02, .2003E+02, .2113E+02,         DCO2 125
     * .5192E+02, .6577E+02, .8653E+02, .1212E+03, .1708E+03,         DCO2 126
     * .2285E+03, .2421E+03, .2285E+03, .2008E+03, .1754E+03,         DCO2 127
     * .1500E+03, .1292E+03, .1119E+03, .9692E+02, .8424E+02,         DCO2 128
     * .7268E+02, .1580E+02, .1375E+02, .1170E+02/                    DCO2 129
      DATA (BCO2(6,J),J= 1, 60)/                                      DCO2 130
     * 0.       , 0.       , .8550E+03, .8529E+03, .8490E+03,         DCO2 131
     * .8420E+03, .8378E+03, .8350E+03, .8241E+03, .8144E+03,         DCO2 132
     * .8307E+03, .7786E+03, .7591E+03, .7109E+03, .6693E+03,         DCO2 133
     * .6210E+03, .5658E+03, .5175E+03, .4802E+03, .4210E+03,         DCO2 134
     * .3727E+03, .3312E+03, .2859E+03, .2596E+03, .2347E+03,         DCO2 135
     * .2057E+03, .1670E+03, .1380E+03, .1325E+03, .1242E+03,         DCO2 136
     * .1308E+03, .7039E+02, .1034E+03, .6787E+02, .3879E+02,         DCO2 137
     * .2684E+02, .2748E+02, .1476E+02, .9625E+01, .2972E+01,         DCO2 138
     * .1187E+01, .5785E+00, 0.       , 0.       , .1372E+03,         DCO2 139
     * .1372E+03, .1372E+03, .1372E+03, .1372E+03, .1372E+03,         DCO2 140
     * .1372E+03, .1372E+03, .1372E+03, .1372E+03, .1372E+03,         DCO2 141
     * .1383E+03, .1416E+03, .1449E+03, .1493E+03, .1564E+03/         DCO2 142
      DATA (BCO2(6,J),J=61,114)/                                      DCO2 143
     * .1646E+03, .1756E+03, .1894E+03, .2058E+03, .2250E+03,         DCO2 144
     * .2470E+03, .2908E+03, .3896E+03, .4939E+03, .5212E+03,         DCO2 145
     * .5377E+03, .5487E+03, .5708E+03, .5873E+03, .6201E+03,         DCO2 146
     * .6476E+03, .6586E+03, .6038E+03, .3841E+03, .2415E+03,         DCO2 147
     * .1729E+03, .1290E+03, .9549E+02, .7299E+02, .5763E+02,         DCO2 148
     * .4664E+02, .3951E+02, .3511E+02, .3018E+02, .2580E+02,         DCO2 149
     * .2360E+02, .2141E+02, .2003E+02, .2003E+02, .2113E+02,         DCO2 150
     * .5192E+02, .6577E+02, .8653E+02, .1212E+03, .1708E+03,         DCO2 151
     * .2285E+03, .2421E+03, .2285E+03, .2008E+03, .1754E+03,         DCO2 152
     * .1500E+03, .1292E+03, .1119E+03, .9692E+02, .8424E+02,         DCO2 153
     * .7268E+02, .1580E+02, .1375E+02, .1170E+02/                    DCO2 154
      DATA (BCO2(7,J),J= 1, 60)/                                      DCO2 155
     * .1264E+04, .1253E+04, .1196E+04, .1170E+04, .1187E+04,         DCO2 156
     * .1343E+04, .9797E+03, .9161E+03, .8525E+03, .7761E+03,         DCO2 157
     * .7251E+03, .6615E+03, .6107E+03, .5597E+03, .5216E+03,         DCO2 158
     * .4771E+03, .4326E+03, .3944E+03, .3499E+03, .3117E+03,         DCO2 159
     * .2747E+03, .2442E+03, .2162E+03, .1882E+03, .1654E+03,         DCO2 160
     * .1425E+03, .1247E+03, .1081E+03, .9415E+02, .7889E+02,         DCO2 161
     * .6233E+02, .4453E+02, .7079E+02, .4182E+02, .2573E+02,         DCO2 162
     * .1833E+02, .1800E+02, .9551E+01, .5836E+01, .1617E+01,         DCO2 163
     * .5333E+00, .2989E+00, 0.       , 0.       , .1372E+03,         DCO2 164
     * .1372E+03, .1372E+03, .1372E+03, .1372E+03, .1372E+03,         DCO2 165
     * .1372E+03, .1372E+03, .1372E+03, .1372E+03, .1372E+03,         DCO2 166
     * .1383E+03, .1416E+03, .1449E+03, .1493E+03, .1564E+03/         DCO2 167
      DATA (BCO2(7,J),J=61,114)/                                      DCO2 168
     * .1646E+03, .1756E+03, .1894E+03, .2058E+03, .2250E+03,         DCO2 169
     * .2470E+03, .2908E+03, .3896E+03, .4939E+03, .5212E+03,         DCO2 170
     * .5377E+03, .5487E+03, .5708E+03, .5873E+03, .6201E+03,         DCO2 171
     * .6476E+03, .6586E+03, .6038E+03, .3841E+03, .2415E+03,         DCO2 172
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     * .1729E+03, .1293E+03, .9549E+02, .7299E+02, .5763E+02,        DC02
     * .4568E+02, .3951E+02, .3511E+02, .3018E+02, .2580E+02,        DC02
     * .2760E+02, .2141E+02, .2003E+02, .2003E+02, .2113E+02,        DC02
     * .5192E+02, .6577E+02, .8653E+02, .1212E+03, .1708E+03,        DC02
     * .2285E+03, .2421E+03, .2285E+03, .2008E+03, .1754E+03,        DC02
     * .1580E+03, .1292E+03, .1119E+03, .9692E+02, .8424E+02,        DC02
     * .7269E+02, .1580E+02, .1376E+02, .1170E+02/                   DC02
      DATA (KCO2(1,J),J= 1, 60)/                                     DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * [illegible]E-05, .3[illegible]E-05, .2501E-05, .1993E-04, .1632E-04,        DC02
     * .1407E-0[illegible], .2373E-0[illegible], .2[illegible]E-04, .4154E-04, .4559E-04,        DC02
     * .63[illegible], .7957E-04, .1900E-03, .4274E-03, .6845E-03,        DC02
     * .17[illegible]E-03, .3282E-02, .1258E-01, .2706E-01, .9874E-01,        DC02
     * .1[illegible]E+0[illegible], .1330E+0[illegible], .2565E+00, .4958E+00, .5443E+00,        DC02
     * .[illegible]E+0[illegible], .5161E+00, .4423E+00, .5[illegible]E+00, .8927E+00,        DC02
     * .1[illegible]E+0[illegible], .2274E+01, .3764E+01, .5553E+01, .1314E+02/        DC02
      DATA (KCO2(1,J),J=61,120)/                                     DC02
     * .1618E+02, .2003E+02, .1606E+02, .1729E+02, .1869E+02,        DC02
     * .1672E+02, .1705E+02, .2010E+02, .2840E+02, .2351E+02,        DC02
     * .1597E+02, .8191E+01, .3232E+01, .9355E+00, .2362E+00,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , .1103E-31, .2203E-31, .8768E-30, .3397E-28,        DC02
     * .12[illegible]E-2[illegible], .4740E-25, .1442E-23, .4549E-22, .1358E-20,        DC02
     * .38[illegible]E-19, .1089E-17, .2493E-16, .5730E-15, .1219E-13/        DC02
      DATA (KCO2(1,J),J=121,176)/                                    DC02
     * .2385E-12, .4262E-11, .6900E-10, .1803E-08, .1295E-07,        DC02
     * .1457E-0[illegible], .5303E-05, .1198E-04, .8339E-04, .4747E-03,        DC02
     * .2162E-02, .4[illegible]E-01, .2125E-01, .4482E-01, .6359E-01,        DC02
     * .8510E-01, .1106E+00, .1405E+00, .2826E+00, .4404E+00,        DC02
     * .5792E+00, .6342E+00, .5391E+00, .2525E+00, .1824E+00,        DC02
     * .6008E+00, .8115E+00, .7264E+00, .4525E+00, .1890E+00,        DC02
     * .4820E-01, .7095E-01, .3107E-01, .7331E-01, .1776E-01,        DC02
     * .4343E-01, .8591E-01, .1691E+00, .3051E+00, .4982E+00,        DC02
     * .7218E+00, .8999E+00, .9102E+00, .6359E+00, .6328E-01,        DC02
     * .6949E-00, .1159E+01, .1256E+01, .9516E+00, .5002E+00,        DC02
     * .1869E+00, .4535E-01, .7247E-02, .7286E-03, .2915E-04,        DC02
     * .1379E-26/                                                    DC02
      DATA (KCO2(2,J),J= 1, 60)/                                     DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , 0.       ,        DC02
     * 0.       , 0.       , 0.       , 0.       , .3728E-03,        DC02
     * .7156E-03, .1444E-02, .2760E-02, .5202E-02, .9661E-02,        DC02
     * .1767E-01, .3183E-01, .5641E-01, .9829E-01, .1683E+00,        DC02
     * .2839E+00, .4667E+00, .7550E+00, .1197E+01, .1856E+01,        DC02
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     * .2816E+01, .4174E+01, .6832E+01, .8490E+01, .1162E+02,      DC02  230
     * .1550E+02, .1989E+02, .2482E+02, .2934E+02, .3349E+02/      DC02  231
      DATA (KCO2(2,J),J=61,120)/                                   DC02  232
     * .3552E+02, .3616E+02, .3401E+02, .2931E+02, .2640E+02,      DC02  233
     * .2382E+02, .3627E+02, .4701E+02, .5033E+02, .4548E+02,      DC02  234
     * .3436E+02, .2695E+02, .9634E+01, .2886E+01, .3776E+00,      DC02  235
     * 0.        , 0.        , 0.        , 0.        , 0.        , DC02  236
     * 0.        , 0.        , 0.        , 0.        , 0.        , DC02  237
     * 0.        , 0.        , 0.        , 0.        , 0.        , DC02  238
     * 0.        , 0.        , 0.        , 0.        , 0.        , DC02  239
     * 0.        , 0.        , 0.        , .3505E-19, .7018E-19,   DC02  240
     * .1554E-17, .3133E-17, .6243E-16, .1218E-15, .2302E-14,      DC02  241
     * .4483E-14, .7724E-13, .1500E-12, .2331E-11, .4512E-11,      DC02  242
     * .2368E-10, .1204E-09, .5914E-09, .2882E-08, .1276E-07,      DC02  243
     * .5572E-07, .2324E-06, .9225E-06, .3473E-05, .1230E-04/      DC02  244
      DATA (KCO2(2,J),J=121,176)/                                  DC02  245
     * .4391E-04, .1267E-03, .3632E-03, .9565E-03, .2299E-02,      DC02  246
     * .5317E-02, .9936E-02, .1799E-01, .3103E-01, .5290E-01,      DC02  247
     * .8412E-01, .1228E+00, .1684E+00, .1912E+00, .2163E+00,      DC02  248
     * .2537E+00, .2716E+00, .2645E+00, .3579E+00, .4281E+00,      DC02  249
     * .4560E+00, .4255E+00, .3292E+00, .1743E+00, .1063E+00,      DC02  250
     * .2321E+00, .3494E+00, .4134E+00, .3977E+00, .3130E+00,      DC02  251
     * .2313E+00, .1127E+00, .7624E-01, .8834E-01, .1290E+00,      DC02  252
     * .1881E+00, .2671E+00, .3634E+00, .4691E+00, .5696E+00,      DC02  253
     * .6423E+00, .6584E+00, .5888E+00, .4169E+00, .1545E+00,      DC02  254
     * .3365E+00, .5998E+00, .5751E+00, .9845E+00, .9013E+00,      DC02  255
     * .6716E+00, .3965E+00, .1762E+00, .5455E-01, .1048E-01,      DC02  256
     * .6896E-03/                                                  DC02  257
      DATA (KCO2(3,J),J= 1, 60)/                                   DC02  258
     * 0.        , 0.        , 0.        , 0.        , 0.        , DC02  259
     * 0.        , 0.        , 0.        , 0.        , 0.        , DC02  260
     * 0.        , 0.        , 0.        , 0.        , 0.        , DC02  261
     * 0.        , 0.        , 0.        , 0.        , 0.        , DC02  262
     * 0.        , 0.        , 0.        , 0.        , .3746E-01,  DC02  263
     * .7491E-01, .1012E+00, .1357E+00, .1807E+00, .2388E+00,      DC02  264
     * .3134E+00, .4081E+00, .5274E+00, .6765E+00, .8611E+00,      DC02  265
     * .1088E+01, .1364E+01, .1702E+01, .2110E+01, .2606E+01,      DC02  266
     * .3191E+01, .3883E+01, .4690E+01, .5614E+01, .6679E+01,      DC02  267
     * .7846E+01, .9179E+01, .1058E+02, .1213E+02, .1368E+02,      DC02  268
     * .1533E+02, .1689E+02, .1842E+02, .1985E+02, .2092E+02,      DC02  269
     * .2209E+02, .2241E+02, .2329E+02, .2380E+02, .2327E+02/      DC02  270
      DATA (KCO2(3,J),J=61,120)/                                   DC02  271
     * .2263E+02, .2262E+02, .2275E+02, .2238E+02, .2308E+02,      DC02  272
     * .2282E+02, .2523E+02, .2620E+02, .2546E+02, .2319E+02,      DC02  273
     * .1360E+02, .1508E+02, .1063E+02, .5809E+01, .2817E+01,      DC02  274
     * 0.        , 0.        , 0.        , 0.        , 0.        , DC02  275
     * 0.        , 0.        , 0.        , 0.        , 0.        , DC02  276
     * 0.        , 0.        , 0.        , .2145E-09, .4290E-09,   DC02  277
     * .1516E-08, .2602E-08, .8828E-08, .1505E-07, .4883E-07,      DC02  278
     * .8260E-07, .2549E-06, .4271E-06, .1246E-05, .2064E-05,      DC02  279
     * .4412E-05, .9237E-05, .1891E-04, .3780E-04, .7361E-04,      DC02  280
     * .1394E-03, .2558E-03, .4542E-03, .7774E-03, .1279E-02,      DC02  281
     * .2017E-02, .3041E-02, .4378E-02, .6029E-02, .8331E-02,      DC02  282
     * .1155E-01, .1586E-01, .2104E-01, .2806E-01, .3617E-01/      DC02  283
      DATA (KCO2(3,J),J=121,176)/                                  DC02  284
     * .4583E-01, .5315E-01, .7424E-01, .9206E-01, .1112E+00,      DC02  285
     * .1351E+00, .1548E+00, .1857E+00, .2054E+00, .2310E+00,      DC02  286
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     * .2493E+00, .2656E+00, .2763E+00, .2544E+00, .2611E+00,        DC02  287
     * .2673E+00, .2531E+00, .2583E+00, .2784E+00, .2986E+00,        DC02  288
     * .2403E+00, .2621E+00, .2413E+00, .2004E+00, .1958E+00,        DC02  289
     * .1911E+00, .2163E+00, .2415E+00, .2752E+00, .3089E+00,        DC02  290
     * .3249E+00, .3407E+00, .1877E+00, .3471E+00, .2197E+00,        DC02  291
     * .4056E+00, .4544E+00, .5942E+00, .5254E+00, .5465E+00,        DC02  292
     * .5122E+00, .4786E+00, .4041E+00, .3296E+00, .3313E+00,        DC02  293
     * .3332E+00, .4776E+00, .6222E+00, .6958E+00, .7695E+00,        DC02  294
     * .6533E+00, .6171E+00, .4440E+00, .2718E+00, .1505E+00,        DC02  295
     * .3310E-01/                                                    DC02  296
      DATA (KOO2(4,J),J= 1, 60)/                                     DC02  297
     * 0.,        0.,        0.,        0.,        0.,               DC02  298
     * 0.,        0.,        0.,        0.,        .6525E-04,        DC02  299
     * .1300E-03, .3076E-03, .4849E-03, .1095E-02, .1712E-02,        DC02  300
     * .3710E-02, .5709E-02, .1178E-01, .1785E-01, .3491E-01,        DC02  301
     * .5190E-01, .6605E-01, .1390E+00, .2216E+00, .3437E+00,        DC02  302
     * .5212E+00, .6468E+00, .7724E+00, .9485E+00, .1125E+01,        DC02  303
     * .1370E+01, .1612E+01, .1994E+01, .2260E+01, .2734E+01,        DC02  304
     * .3151E+01, .3753E+01, .4326E+01, .5042E+01, .5758E+01,        DC02  305
     * .[illegible], .7500E+01, .8496E+01, .9489E+01, .1055E+02,     DC02  306
     * .1160E+02, .1285E+02, .1398E+02, .1517E+02, .1620E+02,        DC02  307
     * .17[illegible], .1812E+02, .1907E+02, .1964E+02, .2000E+02,   DC02  308
     * .2034E+02, .2036E+02, .2092E+02, .2045E+02, .2072E+02/        DC02  309
      DATA (KOO2(4,J),J=61,120)/                                     DC02  310
     * .2[illegible], .2039E+02, .2053E+02, .2115E+02, .2033E+02,    DC02  311
     * .202[illegible], .1989E+02, .2047E+02, .1939E+02, .1659[illegible], DC02  312
     * .146[illegible], .1080E+02, .5434E+01, .4217E+01, 0.,         DC02  313
     * 0.,        0.,        0.,        0.,        0.,               DC02  314
     * 0.,        0.,        0.,        0.,        0.,               DC02  315
     * 0.,        0.,        0.,        0.,        0.,               DC02  316
     * 0.,        0.,        0.,        .1341E-04, .2723E-04,        DC02  317
     * .4[illegible], .8452E-04, .1[illegible]E-03, .2410E-03, .3953E-03, DC02  318
     * .62[illegible]E-03, .9745E-03, .[illegible]3E-02, .2125E-02, .2951E-02, DC02  319
     * .40[illegible]E-02, .5252E-02, .6917E-02, .[illegible]725E-02, .1195E-01, DC02  320
     * .15[illegible]E-01, .1942E-01, .2412E-01, .[illegible]08E-01, .3688E-01, DC02  321
     * .45[illegible]E-01, .5462E-01, .6493E-01, .7662E-01, .9178E-01/ DC02  322
      DATA (KOO2(4,J),J=121,176)/                                    DC02  323
     * .1309E+00, .1254E+00, .1433E+00, .1640E+00, .1816E+00,        DC02  324
     * .2038E+00, .21[illegible]E+00, .2422E+00, .2477E+00, .2652E+00, DC02  325
     * .2685E+00, .2697E+00, .2818E+00, .2556E+00, .2622E+00,        DC02  326
     * .2677E+00, .2632E+00, .2597E+00, .2774E+00, .2961E+00,        DC02  327
     * .2956E+00, .2952E+00, .2798E+00, .2643E+00, .2641E+00,        DC02  328
     * .2636E+00, .2797E+00, .2957E+00, .3366E+00, .3776E+00,        DC02  329
     * .4319E+00, .4251E+00, .5323E+00, .4385E+00, .4495E+00,        DC02  330
     * .4645E+00, .4921E+00, .5236E+00, .5303E+00, .5168E+00,        DC02  331
     * .5345E+00, .4722E+00, .4234E+00, .3745E+00, .3533E+00,        DC02  332
     * .3918E+00, .4953E+00, .5938E+00, .6403E+00, .6947E+00,        DC02  333
     * .6351E+00, .5755E+00, .4339E+00, .2923E+00, .1667E+00,        DC02  334
     * .4100E-01/                                                    DC02  335
      DATA (KOO2(5,J),J= 1, 60)/                                     DC02  336
     * 0.,        0.,        0.,        0.,        0.,               DC02  337
     * 0.,        0.,        0.,        0.,        0.,               DC02  338
     * 0.,        0.,        0.,        0.,        0.,               DC02  339
     * 0.,        0.,        0.,        0.,        .1451E+00,        DC02  340
     * .2523E+00, .4157E+00, .5813E+00, .8043E+00, .1174E+01,        DC02  341
     * .1501E+01, .1759E+01, .2016E+01, .2340E+01, .2664E+01,        DC02  342
     * .3100E+01, .3467E+01, .3960E+01, .4453E+01, .5237E+01,        DC02  343
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     * .5621E+01, .6284E+01, .6975E+01, .7786E+01, .8493E+01,           DC02  344
     * .9294E+01, .1016E+02, .1098E+02, .1185E+02, .1276E+02,           DC02  345
     * .1351E+02, .1439E+02, .1521E+02, .1585E+02, .1640E+02,           DC02  346
     * .1697E+02, .1734E+02, .1789E+02, .1793E+02, .1817E+02,           DC02  347
     * .1558E+02, .1609E+02, .1849E+02, .1849E+02, .1815E+02/           DC02  348
      DATA (KCO2(5,J),J=61,120)/                                        DC02  349
     * .1775E+02, .1766E+02, .1745E+02, .1785E+02, .1654E+02,           DC02  350
     * .1580E+02, .1706E+02, .1556E+02, .1464E+02, .1223E+03,           DC02  351
     * .1036E+02, .4992E+01, .6427E+01, .3314E+01, .2496E+01,           DC02  352
     * 0.        , 0.        , 0.        , 0.        , 0.        ,      DC02  353
     * 0.        , 0.        , 0.        , 0.        , 0.        ,      DC02  354
     * 0.        , 0.        , 0.        , 0.        , 0.        ,      DC02  355
     * 0.        , 0.        , 0.        , .5917E-03, .1183E-02,        DC02  356
     * .1661E-02, .2267E-02, .3003E-02, .3853E-02, .4785E-02,           DC02  357
     * .6350E-02, .7677E-02, .9785E-02, .1225E-01, .1519E-01,           DC02  358
     * .1821E-01, .2185E-01, .2639E-01, .3111E-01, .3726E-01,           DC02  359
     * .4405E-01, .5182E-01, .5966E-01, .7100E-01, .8066E-01,           DC02  360
     * .9186E-01, .1064E+00, .1185E+00, .1354E+00, .1511E+00/           DC02  361
      DATA (KCO2(5,J),J=121,176)/                                       DC02  362
     * .1681E+00, .1812E+00, .2052E+00, .2143E+00, .2242E+00,           DC02  363
     * .2442E+00, .2469E+00, .2664E+00, .2695E+00, .2772E+00,           DC02  364
     * .2593E+00, .3033E+00, .2837E+00, .2643E+00, .2740E+00,           DC02  365
     * .2836E+00, .2809E+00, .2782E+00, .3004E+00, .3226E+00,           DC02  366
     * .3264E+00, .3301E+00, .3345E+00, .3393E+00, .3383E+00,           DC02  367
     * .3177E+00, .3706E+00, .4035E+00, .4180E+00, .4325E+00,           DC02  368
     * .4536E+00, .4746E+00, .4803E+00, .4859E+00, .4841E+00,           DC02  369
     * .4922E+00, .5205E+00, .5187E+00, .5214E+00, .5241E+00,           DC02  370
     * .5332E+00, .4822E+00, .4554E+00, .4286E+00, .4337E+00,           DC02  371
     * .4388E+00, .4942E+00, .5496E+00, .5735E+00, .5973E+00,           DC02  372
     * .5457E+00, .4942E+00, .3840E+00, .2738E+00, .1594E+00,           DC02  373
     * .4508E-01/                                                       DC02  374
      DATA (KCO2(6,J),J= 1, 60)/                                        DC02  375
     * 0.        , 0.        , 0.        , 0.        , 0.        ,      DC02  376
     * 0.        , 0.        , 0.        , 0.        , .6443E+01,       DC02  377
     * .1289E+00, .1727E+00, .2284E+00, .2985E+00, .3883E+00,           DC02  378
     * .5130E+00, .6483E+00, .8320E+00, .1059E+01, .1331E+01,           DC02  379
     * .1563E+01, .2058E+01, .2539E+01, .3083E+01, .3717E+01,           DC02  380
     * .4521E+01, .4899E+01, .5276E+01, .5722E+01, .6169E+01,           DC02  381
     * .6652E+01, .7136E+01, .7724E+01, .8313E+01, .8829E+01,           DC02  382
     * .9344E+01, .9870E+01, .1040E+02, .1090E+02, .1140E+02,           DC02  383
     * .1200E+02, .1261E+02, .1298E+02, .1336E+02, .1366E+02,           DC02  384
     * .1395E+02, .1479E+02, .1562E+02, .1525E+02, .1489E+02,           DC02  385
     * .1483E+02, .1477E+02, .1462E+02, .1447E+02, .1510E+02,           DC02  386
     * .1574E+02, .1434E+02, .1474E+02, .1594E+02, .1384E+02/           DC02  387
      DATA (KCO2(6,J),J=61,120)/                                        DC02  388
     * .1328E+02, .1271E+02, .1202E+02, .1308E+02, .1039E+02,           DC02  389
     * .1113E+02, .1177E+02, .9080E+01, .8851E+01, .6587E+01,           DC02  390
     * .6127E+01, .3566E+01, .3568E+01, .1585E+01, .1502E+01,           DC02  391
     * 0.        , 0.        , 0.        , 0.        , 0.        ,      DC02  392
     * 0.        , 0.        , 0.        , 0.        , 0.        ,      DC02  393
     * 0.        , .3399E-02, .6798E-02, .8290E-02, .9782E-02,          DC02  394
     * .1131E-01, .1324E-01, .1565E-01, .1806E-01, .2132E-01,           DC02  395
     * .2459E-01, .2755E-01, .3052E-01, .3505E-01, .3958E-01,           DC02  396
     * .4569E-01, .5179E-01, .5728E-01, .6296E-01, .7520E-01,           DC02  397
     * .7927E-01, .8682E-01, .9940E-01, .1071E+00, .1179E+00,           DC02  398
     * .1334E+00, .1425E+00, .1495E+00, .1785E+00, .1763E+00,           DC02  399
     * .1851E+00, .2063E+00, .2116E+00, .2256E+00, .2471E+00/           DC02  400
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      DATA (KCO2(6,J),J=121,176)/                                      DC02
     * .2516E+00, .2403E+00, .3828E+00, .2694E+00, .2682E+00,          DC02
     * .2328E+00, .2819E+00, .2988E+00, .3137E+00, .3192E+00,          DC02
     * .3306E+00, .4230E+00, .3358E+00, .3353E+00, .3588E+00,          DC02
     * .3662E+00, .3684E+00, .3705E+00, .3965E+00, .4225E+00,          DC02
     * .4277E+00, .4335E+00, .4521E+00, .4712E+00, .4662E+00,          DC02
     * .4613E+00, .4948E+00, .5283E+00, .5218E+00, .5154E+00,          DC02
     * .5254E+00, .5354E+00, .5375E+00, .5397E+00, .5302E+00,          DC02
     * .5207E+00, .5277E+00, .5346E+00, .5389E+00, .5429E+00,          DC02
     * .5340E+00, .5252E+00, .5161E+00, .4950E+00, .4830E+00,          DC02
     * .4649E+00, .4603E+00, .4557E+00, .4482E+00, .4407E+00,          DC02
     * .3279E+00, .3450E+00, .2709E+00, .1967E+00, .1119E+00,          DC02
     * .3681E-01/                                                      DC02
      DATA (KCO2(7,J),J= 1, 60)/                                       DC02
     * .6023E-01, .8943E-01, .1144E+00, .1447E+00, .1812E+00,          DC02
     * .2259E+00, .2815E+00, .3504E+00, .4352E+00, .5372E+00,          DC02
     * .6558E+00, .8004E+00, .9665E+00, .1159E+01, .1427E+01,          DC02
     * .1552E+01, .1995E+01, .2295E+01, .2592E+01, .3171E+01,          DC02
     * .3651E+01, .4150E+01, .4881E+01, .5474E+01, .6125E+01,          DC02
     * [illegible], .749[illegible], .7673E+01, .8006E+01, .8339E+01,  DC02
     * .8571E+01, .9000E+01, .9742E+01, .1048E+02, .1057E+02,          DC02
     * [illegible], .1097E+02, .1110E+02, .1127E+02, .1145E+02,        DC02
     * .1231E+02, .1257E+02, .1292E+02, .1247E+02, .1241E+02,          DC02
     * .1236E+02, .1390E+02, .1544E+02, .1398E+02, .1252E+02,          DC02
     * .1216E+02, .1161E+02, .1143E+02, .1105E+02, .1211E+02,          DC02
     * .1317E+02, .1223E+02, .1129E+02, .1064E+02, .9987E+01/          DC02
      DATA (KCO2(7,J),J=61,120)/                                       DC02
     * .9281E+01, .8595E+01, .9926E+01, .9257E+01, .8216E+01,          DC02
     * .7175E+01, .6247E+01, .5319E+01, .4436E+01, .3553E+01,          DC02
     * .2561E+01, .1753E+01, .1263E+01, .7741E+00, 0.,                 DC02
     * 0.,        0.,        .1166E-01, .1273E-01, .1373E-01,          DC02
     * .1562E-01, .1762E-01, .2032E-01, .2303E-01, .2487E-01,          DC02
     * .2675E-01, .3016E-01, .3356E-01, .3803E-01, .4250E-01,          DC02
     * .4593E-01, .4929E-01, .5510E-01, .6091E-01, .6901E-01,          DC02
     * .7578E-01, .8107E-01, .8336E-01, .9171E-01, .1001E+00,          DC02
     * .1124E+00, .1248E+00, .1276E+00, .1304E+00, .1414E+00,          DC02
     * .1524E+00, .1667E+00, .1811E+00, .1860E+00, .1908E+00,          DC02
     * .2041E+00, .2174E+00, .2468E+00, .2761E+00, .2389E+00,          DC02
     * .2397E+00, .2705E+00, .2637E+00, .2718E+00, .3126E+00/          DC02
      DATA (KCO2(7,J),J=121,176)/                                      DC02
     * .2939E+00, .2801E+00, .3865E+00, .3053E+00, .3027E+00,          DC02
     * .3389E+00, .3314E+00, .3501E+00, .3913E+00, .3899E+00,          DC02
     * .3694E+00, .5155E+00, .4173E+00, .4292E+00, .4436E+00,          DC02
     * .4590E+00, .4608E+00, .4634E+00, .4922E+00, .5008E+00,          DC02
     * .5129E+00, .5050E+00, .5216E+00, .5383E+00, .5337E+00,          DC02
     * .5290E+00, .5549E+00, .5807E+00, .5683E+00, .5558E+00,          DC02
     * .5630E+00, .5642E+00, .5646E+00, .5651E+00, .5555E+00,          DC02
     * .5459E+00, .5468E+00, .5477E+00, .5485E+00, .5493E+00,          DC02
     * .5376E+00, .5259E+00, .5038E+00, .4817E+00, .4478E+00,          DC02
     * .4177E+00, .3845E+00, .3513E+00, .3315E+00, .3118E+00,          DC02
     * .2708E+00, .2300E+00, .1793E+00, .1285E+00, .7680E-01,          DC02
     * .2507E-01/                                                      DC02
      END                                                              DC02
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      BLOCK DATA H2O                                                    DAH20
      DIMENSION COEF1(7,19),COEF2(7,19),COEF3(7,19),COEF4(7,19),        DAH20
     1COEF5(7,19),COEF6(7,19),COEF7(7,19),COEF8(7,19),COEF9(7,19),      DAH20
     2COEF10(7,19),COEF11(7,19),COEF12(7,19),COEF13(7,19),COEF14(7,19), DAH20
     3COEF15(7,19),COEF16(7,19),COEF17(7,19),COEF18(7,19),COEF19(7,19), DAH20
     4COEF20(7,19),COEF21(7,19),COEF22(7,19),COEF23(7,19),COEF24(7,2),  DAH20
     5COEF25(7,19),COEF26(7,19),COEF27(7,19),COEF28(7,19),COEF29(7,19), DAH20
     6COEF30(7,19),COEF31(7,19),COEF32(7,19),COEF33(7,19),COEF34(7,19), DAH20
     7COEF35(7,19),COEF36(7,19),COEF37(7,19),COEF38(7,19),COEF39(7,19), DAH20
     8COEF40(7,19),COEF41(7,19),COEF42(7,19),COEF43(7,19),COEF44(7,19), DAH20
     9COEF45(7,19),COEF46(7,19),COEF47(7,19),COEF48(7,2)                DAH20
      COMMON/BETAK1/COEF(7,876)                                         DAH20
C DATA INSERTED IN ORDER OF KH2O(7,439) AND BH2O(7,439)                 DAH20
      EQUIVALENCE (COEF(1,1),COEF1(1,1)), (COEF(1,20),COEF2(1,1)),      DAH20
     1(COEF(1,39),COEF3(1,1)), (COEF(1,58),COEF4(1,1)),                 DAH20
     2(COEF(1,77),COEF5(1,1)), (COEF(1,96),COEF6(1,1)),                 DAH20
     3(COEF(1,115),COEF7(1,1)), (COEF(1,134),COEF8(1,1)),               DAH20
     4(COEF(1,153),COEF9(1,1)), (COEF(1,172),COEF10(1,1)),              DAH20
     5(COEF(1,191),COEF11(1,1)), (COEF(1,210),COEF12(1,1)),             DAH20
     6(COEF(1,229),COEF13(1,1)), (COEF(1,248),COEF14(1,1)),             DAH20
     7(COEF(1,267),COEF15(1,1)), (COEF(1,286),COEF16(1,1)),             DAH20
     8(COEF(1,305),COEF17(1,1)), (COEF(1,324),COEF18(1,1)),             DAH20
     9(COEF(1,343),COEF19(1,1)), (COEF(1,362),COEF20(1,1)),             DAH20
     A(COEF(1,381),COEF21(1,1)), (COEF(1,400),COEF22(1,1)),             DAH20
     B(COEF(1,419),COEF23(1,1)), (COEF(1,438),COEF24(1,1)),             DAH20
     C(COEF(1,440),COEF25(1,1)), (COEF(1,459),COEF26(1,1)),             DAH20
     D(COEF(1,478),COEF27(1,1)), (COEF(1,497),COEF28(1,1)),             DAH20
     E(COEF(1,516),COEF29(1,1)), (COEF(1,535),COEF30(1,1)),             DAH20
     F(COEF(1,554),COEF31(1,1)), (COEF(1,573),COEF32(1,1)),             DAH20
     G(COEF(1,592),COEF33(1,1)), (COEF(1,611),COEF34(1,1)),             DAH20
     H(COEF(1,630),COEF35(1,1)), (COEF(1,649),COEF36(1,1)),             DAH20
     I(COEF(1,668),COEF37(1,1)), (COEF(1,687),COEF38(1,1)),             DAH20
     J(COEF(1,706),COEF39(1,1)), (COEF(1,725),COEF40(1,1))              DAH20
      EQUIVALENCE (COEF(1,744),COEF41(1,1)), (COEF(1,763),COEF42(1,1)), DAH20
     1(COEF(1,782),COEF43(1,1)), (COEF(1,801),COEF44(1,1)),             DAH20
     2(COEF(1,820),COEF45(1,1)), (COEF(1,839),COEF46(1,1)),             DAH20
     3 (COEF(1,858),COEF47(1,1)),(COEF(1,877),COEF48(1,1))              DAH20
      DATA COEF1/                                                       DAH20
     1.9500E-0,.1030E-0,.4200E-1,.1140E-1,.4500E-2,.3000E-2,.1900E-2,   DAH20
     1.2300E+1,.3650E-0,.1130E-0,.3750E-1,.1950E-1,.1340E-1,.6700E-2,   DAH20
     1.3860E+1,.9900E-0,.3000E-0,.1040E-0,.5770E-1,.3650E-1,.2110E-1,   DAH20
     1.6500E+1,.2310E+1,.6500E-0,.2140E-0,.1280E-0,.8450E-1,.5290E-1,   DAH20
     1.8250E+1,.3250E+1,.1210E+1,.4150E-0,.2600E-0,.1680E-0,.1090E-0,   DAH20
     1.8700E+1,.4520E+1,.1890E+1,.7650E-0,.4500E-0,.2990E-0,.1930E-0,   DAH20
     1.8100E+1,.5400E+1,.2610E+1,.1260E+1,.6950E-0,.4500E-0,.3090E-0,   DAH20
     1.6820E+1,.6000E+1,.3370E+1,.1790E+1,.1010E+1,.6790E-0,.4540E-0,   DAH20
     1.4930E+1,.6220E+1,.4070E+1,.2300E+1,.1350E+1,.9350E-0,.6200E-0,   DAH20
     1.3160E+1,.5920E+1,.4560E+1,.2810E+1,.1720E+1,.1220E+1,.8220E-0,   DAH20
     1.1990E+1,.5280E+1,.4790E+1,.3280E+1,.2130E+1,.1490E+1,.1040E+1,   DAH20
     1.1130E+1,.4500E+1,.4840E+1,.3610E+1,.2490E+1,.1790E+1,.1280E+1,   DAH20
     1.5850E-0,.3700E+1,.4710E+1,.3830E+1,.2840E+1,.2080E+1,.1540E+1,   DAH20
     1.2930E-0,.2890E+1,.4430E+1,.3940E+1,.3120E+1,.2370E+1,.1820E+1,   DAH20
     1.1380E-0,.2050E+1,.4000E+1,.3560E+1,.3300E+1,.2600E+1,.2070E+1,   DAH20
     1.6200E-1,.1430E+1,.3470E+1,.3880E+1,.3410E+1,.2800E+1,.2290E+1,   DAH20
     1.2550E-1,.9500E-0,.2920E+1,.3700E+1,.3450E+1,.2350E+1,.2480E+1,   DAH20
     1.9400E-2,.6100E-0,.2360E+1,.3430E+1,.3420E+1,.3040E+1,.2620E+1,   DAH20
     1.3400E-2,.3860E-0,.1880E+1,.3100E+1,.3340E+1,.3090E+1,.2730E+1/   DAH20
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      DATA COEF2/                                                       DAH20  59
     1,1050E-2,.2360E-0,.1450E+1,.2748E+1,.3190E+1,.3070E+1,.2800E+1,   DAH20  60
     1,3500E-3,.1440E-0,.1100E+1,.2380E+1,.3000E+1,.3010E+1,.2830E+1,   DAH20  61
     1,1260E-3,.8200E-1,.8100E-0,.2048E+1,.2750E+1,.2890E+1,.2820E+1,   DAH20  62
     1,4300E-4,.4450E-1,.5980E-0,.1740E+1,.2480E+1,.2750E+1,.2770E+1,   DAH20  63
     1,1500E-4,.2420E-1,.4270E-0,.1450E+1,.2220E+1,.2600E+1,.2690E+1,   DAH20  64
     1,5100E-5,.1270E-1,.2940E-0,.1180E+1,.1950E+1,.2410E+1,.2580E+1,   DAH20  65
     1,1700E-5,.6300E-2,.2000E-0,.9500E-0,.1690E+1,.2210E+1,.2450E+1,   DAH20  66
     1,5700E-6,.3000E-2,.1340E-0,.7480E-0,.1460E+1,.2000E+1,.2290E+1,   DAH20  67
     1,1950E-6,.1430E-2,.9020E-1,.5830E-0,.1240E+1,.1780E+1,.2130E+1,   DAH20  68
     1,6500E-7,.6200E-3,.5900E-1,.4430E-0,.1030E+1,.1560E+1,.1960E+1,   DAH20  69
     1,3650E-7,.2750E-3,.4500E-1,.3300E-0,.8450E-0,.1360E+1,.1770E+1,   DAH20  70
     1,6700E-7,.1130E-3,.3550E-1,.2420E-0,.6950E-0,.1170E+1,.1590E+1,   DAH20  71
     1,1130E-6,.5000E-4,.2890E-1,.1740E-0,.5600E-0,.1000E+1,.1430E+1,   DAH20  72
     1,1350E-6,.2300E-4,.2450E-1,.1230E-0,.4500E-0,.8550E-0,.1260E+1,   DAH20  73
     1,3280E-6,.1030E-4,.2140E-1,.1000E-0,.3570E-0,.7160E-0,.1110E+1,   DAH20  74
     1,5600E-6,.4600E-5,.1890E-1,.8300E-1,.2780E-0,.5950E-0,.9550E-0,   DAH20  75
     1,9500E-6,.2050E-5,.1740E-1,.7300E-1,.2390E-0,.4920E-0,.8250E-0,   DAH20  76
     1,1600E-5,.1400E-5,.1660E-1,.6650E-1,.2110E-0,.4050E-0,.7050E-0,   DAH20  77
     1,2750E-5,.3500E-5,.1650E-1,.6300E-1,.1950E-0,.3520E-0,.6000E-0/   DAH20  78
      DATA COEF3/                                                       DAH20  79
     1,4700E-5,.9500E-5,.1670E-1,.5200E-1,.1900E-0,.3120E-0,.5100E-0,   DAH20  80
     1,8100E-5,.2150E-4,.1750E-1,.6300E-1,.1910E-0,.2890E-0,.4250E-0,   DAH20  81
     1,1350E-4,.5730E-4,.1880E-1,.6750E-1,.1940E-0,.2810E-0,.3560E-0,   DAH20  82
     1,2350E-4,.1500E-3,.2080E-1,.7450E-1,.2020E-0,.2830E-0,.3290E-0,   DAH20  83
     1,4000E-4,.3800E-3,.2330E-1,.8650E-1,.2230E-0,.3140E-0,.3570E-0,   DAH20  84
     1,6800E-4,.9500E-3,.2680E-1,.1220E-0,.2600E-0,.3800E-0,.4490E-0,   DAH20  85
     1,1200E-3,.2450E-2,.3430E-1,.1760E-0,.3280E-0,.4510E-0,.5070E-0,   DAH20  86
     1,2000E-3,.5200E-2,.6380E-1,.2510E-0,.4110E-0,.5110E-0,.5690E-0,   DAH20  87
     1,3650E-3,.1480E-1,.1070E-0,.3300E-0,.4580E-0,.5420E-0,.6040E-0,   DAH20  88
     1,6300E-3,.3300E-1,.1660E-0,.4050E-0,.4870E-0,.5710E-0,.6320E-0,      120  89
     1,1300E-2,.6350E-1,.2440E-0,.4590E-0,.5350E-0,.5570E-0,.6370E-0,   DAH20  90
     1,2500E-2,.1230E-0,.3410E-0,.4770E-0,.5020E-0,.5620E-0,.6080E-0,   DAH20  91
     1,5000E-2,.2120E-0,.4070E-0,.5470E-0,.5310E-0,.5140E-0,.5780E-0,   DAH20  92
     1,1030E-1,.2850E-0,.4890E-0,.5920E-0,.4970E-0,.4860E-0,.5540E-0,   DAH20  93
     1,2190E-1,.3280E-0,.4910E-0,.5580E-0,.4890E-0,.4850E-0,.5370E-0,   DAH20  94
     1,4350E-1,.3450E-0,.5050E-0,.5210E-0,.4770E-0,.4840E-0,.5200E-0,   DAH20  95
     1,1140E-0,.3610E-0,.5380E-0,.5630E-0,.5030E-0,.5020E-0,.5160E-0,   DAH20  96
     1,2490E-0,.4600E-0,.6210E-0,.6240E-0,.5380E-0,.5380E-0,.5140E-0,   DAH20  97
     1,3970E-0,.5690E-0,.7490E-0,.7680E-0,.5810E-0,.5650E-0,.5180E-0/   DAH20  98
      DATA COEF4/                                                       DAH20  99
     1,4190E-0,.6270E-0,.8240E-0,.8490E-0,.6400E-0,.5940E-0,.5300E-0,   DAH20 100
     1,1080E+1,.1250E+1,.1130E+1,.9400E-0,.8070E-0,.6630E-0,.5250E-0,   DAH20 101
     1,1650E+1,.1550E+1,.1180E+1,.6700E-0,.5620E-0,.4830E-0,.4300E-0,   DAH20 102
     1,1420E+1,.6750E-0,.5570E-0,.3490E-0,.2760E-0,.2630E-0,.2770E-0,   DAH20 103
     1,4510E-0,.2020E-0,.1320E-0,.1180E-0,.1340E-0,.1560E-0,.1730E-0,   DAH20 104
     1,6030E-1,.5380E-1,.8630E-1,.1120E-0,.1230E-0,.1250E-0,.1250E-0,   DAH20 105
     1,5210E-1,.2520E-0,.1180E-0,.1120E-0,.1310E-0,.1400E-0,.1430E-0,   DAH20 106
     1,7300E-0,.4300E-0,.2370E-0,.1910E-0,.1710E-0,.1700E-0,.1700E-0,   DAH20 107
     1,1490E+1,.5360E-0,.2940E-0,.2380E-0,.2100E-0,.2010E-0,.2020E-0,   DAH20 108
     1,1000E+1,.5530E-0,.4340E-0,.3400E-0,.2600E-0,.2200E-0,.1730E-0,   DAH20 109
     1,8020E-0,.6580E-0,.5280E-0,.4110E-0,.3000E-0,.2400E-0,.1910E-0,   DAH20 110
     1,5800E-0,.5270E-0,.4600E-0,.3780E-0,.3220E-0,.2830E-0,.2400E-0,   DAH20 111
     1,3300E-0,.4030E-0,.4300E-0,.3560E-0,.3180E-0,.2700E-0,.2260E-0,   DAH20 112
     1,2500E-0,.3930E-0,.4050E-0,.3420E-0,.3010E-0,.2750E-0,.2420E-0,   DAH20 113
     1,1470E-0,.2490E-0,.3130E-0,.3180E-0,.2910E-0,.2580E-0,.2500E-0,   DAH20 114
     1,9100E-1,.2500E-0,.2980E-0,.2950E-0,.2690E-0,.2530E-0,.2470E-0,   DAH20 115
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     1.5880E-1,.1580E-0,.2140E-0,.2440E-0,.2440E-0,.2450E-0,.2380E-0,   DAH20   116
     1.3780E-1,.1130E-0,.1840E-0,.2100E-0,.2140E-0,.2180E-0,.2220E-0,   DAH20   117
     1.2440E-1,.1180E-0,.1560E-0,.1880E-0,.1950E-0,.2000E-0,.2060E-0/   DAH20   118
      DATA COEF5/                                                        DAH20   119
     1.1620E-1,.6860E-1,.9760E-1,.1410E-0,.1660E-0,.1790E-0,.1850E-0,   DAH20   120
     1.1120E-1,.4250E-1,.9030E-1,.1330E-0,.1480E-0,.1560E-0,.1660E-0,   DAH20   121
     1.7800E-2,.4000E-1,.7650E-1,.1120E-0,.1290E-0,.1370E-0,.1470E-0,   DAH20   122
     1.5400E-2,.3520E-1,.6470E-1,.8760E-1,.1100E-0,.1180E-0,.1290E-0,   DAH20   123
     1.3800E-2,.2520E-1,.5070E-1,.7050E-1,.8880E-1,.1000E-0,.1110E-0,   DAH20   124
     1.2600E-2,.1790E-1,.3770E-1,.5460E-1,.7240E-1,.8280E-1,.9600E-1,   DAH20   125
     1.1800E-2,.1230E-1,.2940E-1,.4430E-1,.6080E-1,.6860E-1,.8400E-1,   DAH20   126
     1.1270E-2,.8530E-2,.2120E-1,.3780E-1,.5790E-1,.6400E-1,.7250E-1,   DAH20   127
     1.8800E-3,.6800E-2,.1520E-1,.2750E-1,.4490E-1,.5210E-1,.6280E-1,   DAH20   128
     1.6200E-3,.4000E-2,.1070E-1,.2140E-1,.3740E-1,.4530E-1,.5300E-1,   DAH20   129
     1.4800E-3,.2980E-2,.9310E-2,.1890E-1,.3290E-1,.4030E-1,.4550E-1,   DAH20   130
     1.4150E-3,.1750E-2,.6960E-2,.1520E-1,.2950E-1,.3650E-1,.3980E-1,   DAH20   131
     1.3210E-3,.1200E-2,.4520E-2,.1010E-1,.2520E-1,.3310E-1,.3500E-1,   DAH20   132
     1.2290E-3,.7210E-3,.3640E-2,.9300E-2,.2250E-1,.3050E-1,.3120E-1,   DAH20   133
     1.1950E-3,.5440E-3,.3180E-2,.7500E-2,.2020E-1,.2840E-1,.2900E-1,   DAH20   134
     1.1540E-3,.3750E-3,.1850E-2,.6030E-2,.1750E-1,.2690E-1,.2750E-1,   DAH20   135
     1.1010E-3,.2630E-3,.1190E-2,.4800E-2,.1560E-1,.2530E-1,.2670E-1,   DAH20   136
     1.8520E-4,.1850E-3,.9090E-3,.3600E-2,.1330E-1,.2410E-1,.2590E-1,   DAH20   137
     1.7530E-4,.1370E-3,.7110E-3,.3160E-2,.1220E-1,.2370E-1,.2520E-1/   DAH20   138
      DATA COEF6/                                                        DAH20   139
     1.6150E-4,.1260E-3,.6100E-3,.2570E-2,.1010E-1,.2180E-1,.2510E-1,   DAH20   140
     1.4350E-4,.1130E-3,.5180E-3,.2410E-2,.9200E-2,.2000E-1,.2490E-1,   DAH20   141
     1.3720E-4,.1050E-3,.4350E-3,.1680E-2,.7850E-2,.1830E-1,.2470E-1,   DAH20   142
     1.3550E-4,.1010E-3,.3760E-3,.1680E-2,.6690E-2,.1660E-1,.2480E-1,   DAH20   143
     1.3580E-4,.9900E-4,.3660E-3,.1670E-2,.6510E-2,.1560E-1,.2490E-1,   DAH20   144
     1.3890E-4,.1020E-3,.3760E-3,.1670E-2,.6410E-2,.1520E-1,.2510E-1,   DAH20   145
     1.4220E-4,.1060E-3,.3730E-3,.1680E-2,.6560E-2,.1500E-1,.2530E-1,   DAH20   146
     1.5210E-4,.1110E-3,.3710E-3,.1700E-2,.6730E-2,.1520E-1,.2580E-1,   DAH20   147
     1.6460E-4,.1210E-3,.3840E-3,.1790E-2,.7980E-2,.1790E-1,.2630E-1,   DAH20   148
     1.7420E-4,.1290E-3,.4790E-3,.2010E-2,.7880E-2,.1750E-1,.2700E-1,   DAH20   149
     1.9530E-4,.1650E-3,.5440E-3,.2490E-2,.9450E-2,.2040E-1,.2800E-1,   DAH20   150
     1.1010E-3,.1900E-3,.7810E-3,.3240E-2,.1060E-1,.2310E-1,.2950E-1,   DAH20   151
     1.1470E-3,.2720E-3,.8920E-3,.4410E-2,.1250E-1,.2570E-1,.3180E-1,   DAH20   152
     1.1950E-3,.3260E-3,.1000E-2,.4990E-2,.1470E-1,.2950E-1,.3430E-1,   DAH20   153
     1.2610E-3,.4210E-3,.1450E-2,.5680E-2,.1610E-1,.3060E-1,.3780E-1,   DAH20   154
     1.3050E-3,.5150E-3,.1950E-2,.7540E-2,.1850E-1,.3630E-1,.4170E-1,   DAH20   155
     1.3620E-3,.6450E-3,.2370E-2,.8300E-2,.2050E-1,.3730E-1,.4590E-1,   DAH20   156
     1.5070E-3,.8500E-3,.2740E-2,.8880E-2,.2340E-1,.4310E-1,.5000E-1,   DAH20   157
     1.7990E-3,.1180E-2,.3220E-2,.1100E-1,.2620E-1,.4510E-1,.5500E-1/   DAH20   158
      DATA COEF7/                                                        DAH20   159
     1.9350E-3,.1600E-2,.3860E-2,.1260E-1,.2920E-1,.5300E-1,.6020E-1,   DAH20   160
     1.1080E-2,.2310E-2,.4510E-2,.1400E-1,.3060E-1,.5360E-1,.6650E-1,   DAH20   161
     1.1920E-2,.2710E-2,.5630E-2,.1590E-1,.3570E-1,.6290E-1,.7350E-1,   DAH20   162
     1.2630E-2,.3000E-2,.6250E-2,.1790E-1,.3850E-1,.6660E-1,.8010E-1,   DAH20   163
     1.2950E-2,.3300E-2,.7010E-2,.2030E-1,.4600E-1,.7820E-1,.8850E-1,   DAH20   164
     1.3100E-2,.3700E-2,.9460E-2,.2200E-1,.5190E-1,.8890E-1,.9700E-1,   DAH20   165
     1.3400E-2,.4000E-2,.9690E-2,.2790E-1,.6620E-1,.1090E-0,.1060E-0,   DAH20   166
     1.7300E-2,.4500E-2,.1110E-1,.2720E-1,.6760E-1,.1090E-0,.1170E-0,   DAH20   167
     1.9000E-2,.4800E-2,.1370E-1,.3720E-1,.8640E-1,.1330E-0,.1290E-0,   DAH20   168
     1.1400E-2,.5100E-2,.1620E-1,.4710E-1,.1000E-0,.1420E-0,.1420E-0,   DAH20   169
     1.6400E-3,.5500E-2,.2050E-1,.5300E-1,.1220E-0,.1680E-0,.1550E-0,   DAH20   170
     1.1600E-2,.6000E-2,.2470E-1,.6330E-1,.1350E-0,.1770E-0,.1700E-0,   DAH20   171
     1.3300E-2,.7080E-2,.2830E-1,.7700E-1,.1530E-0,.1850E-0,.1870E-0,   DAH20   172
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     1.4180E-2,.[illegible]E-2,.3760E-1,.9140E-1,.1660E-0,.2860E-0,.2820E-0,   DAH20
     1.4190E-2,.1030E-1,.5140E-1,.1170E-0,.1940E-0,.2200E-0,.2200E-0,    DAH20
     1.2450E-2,.1290E-1,.6640E-1,.1470E-0,.2200E-0,.2540E-0,.2410E-0,    DAH20
     1.2200E-2,.1610E-1,.5340E-1,.1710E-0,.2370E-0,.2630E-0,.2620E-0,    DAH20
     1.2200E-2,.2120E-1,.1030E-0,.2010E-0,.2640E-0,.2830E-0,.2800E-0,    DAH20
     1.2500E-2,.2850E-1,.1350E-0,.2400E-0,.2950E-0,.2950E-0,.2930E-0/    DAH20
      DATA COEF8/                                                        DAH20
     1.3100E-2,.3850E-1,.1690E-0,.2720E-0,.3120E-0,.3810E-0,.3020E-0,    DAH20
     1.4200E-2,.5400E-1,.2140E-0,.3090E-0,.3290E-0,.3070E-0,.3080E-0,    DAH20
     1.6400E-2,.7700E-1,.2670E-0,.3430E-0,.3320E-0,.3140E-0,.3000E-0,    DAH20
     1.9400E-2,.1170E-0,.3330E-0,.3720E-0,.3460E-0,.3030E-0,.2900E-0,    DAH20
     1.1050E-1,.1730E-0,.3650E-0,.3850E-0,.3530E-0,.3000E-0,.2720E-0,    DAH20
     1.3600E-1,.2580E-0,.4380E-0,.3930E-0,.3150E-0,.2880E-0,.2550E-0,    DAH20
     1.7200E-1,.3750E-0,.5100E-0,.4090E-0,.2940E-0,.2710E-0,.2410E-0,    DAH20
     1.1330E-0,.4010E-0,.4990E-0,.3900E-0,.2810E-0,.2570E-0,.2220E-0,    DAH20
     1.2150E-0,.5100E-0,.4430E-0,.3410E-0,.2540E-0,.2300E-0,.2080E-0,    DAH20
     1.3180E-0,.4500E-0,.3460E-0,.2660E-0,.2450E-0,.2190E-0,.2310E-0,    DAH20
     1.4420E-0,.4000E-0,.3540E-0,.2790E-0,.2330E-0,.2160E-0,.2100E-0,    DAH20
     1.4730E-0,.4050E-0,.3470E-0,.2810E-0,.2380E-0,.2190E-0,.2130E-0,    DAH20
     1.5680E-0,.5010E-0,.4230E-0,.3150E-0,.2430E-0,.2180E-0,.2300E-0,    DAH20
     1.6900E-0,.7080E-0,.6730E-0,.4320E-0,.2680E-0,.1890E-0,.1500E-0,    DAH20
     1.6170E-0,.8310E-0,.5660E-0,.3200E-0,.1940E-0,.1230E-0,.1130E-0,    DAH20
     1.1510E+1,.5200E-0,.2000E-0,.1310E-0,.1240E-0,.1070E-0,.1050E-0,    DAH20
     1.1380E-0,.1240E-0,.1200E-0,.1150E-0,.1150E-0,.1150E-0,.1090E-0,    DAH20
     1.4550E-0,.2980E-0,.1670E-0,.1290E-0,.1230E-0,.1120E-0,.1220E-0,    DAH20
     1.7600E-0,.5030E-0,.2420E-0,.1540E-0,.1290E-0,.1270E-0,.1380E-0/    DAH20
      DATA COEF9/                                                        DAH20
     1.8360E-0,.5940E-0,.2770E-0,.1840E-0,.1610E-0,.1450E-0,.1540E-0,    DAH20
     1.8400E-0,.7230E-0,.4220E-0,.2360E-0,.1970E-0,.1570E-0,.1770E-0,    DAH20
     1.5850E-0,.5000E-0,.3790E-0,.2760E-0,.2270E-0,.1920E-0,.1970E-0,    DAH20
     1.1170E-0,.4000E-0,.4230E-0,.3150E-0,.2430E-0,.2320E-0,.2390E-0,    DAH20
     1.4650E-1,.3000E-0,.3580E-0,.2900E-0,.2300E-0,.2020E-0,.2070E-0,    DAH20
     1.1830E-1,.2050E-0,.2690E-0,.2350E-0,.1950E-0,.1920E-0,.1900E-0,    DAH20
     1.7300E-2,.1350E-0,.1860E-0,.1790E-0,.1590E-0,.1580E-0,.1610E-0,    DAH20
     1.5570E-2,.7900E-1,.1130E-0,.1240E-0,.1240E-0,.1340E-0,.1320E-0,    DAH20
     1.2830E-2,.4150E-1,.6620E-1,.8860E-1,.1030E-0,.1160E-0,.1[illegible]E-0,   DAH20
     1.2260E-2,.1970E-1,.3670E-1,.5940E-1,.8010E-1,.8790E-1,.8600E-1,    DAH20
     1.1550E-2,.8500E-2,.2110E-1,.3950E-1,.5030E-1,.6100E-1,.7100E-1,    DAH20
     1.1030E-2,.5210E-2,.1190E-1,.2460E-1,.3540E-1,.4800E-1,.5930E-1,    DAH20
     1.8210E-3,.3650E-2,.7590E-2,.1660E-1,.2560E-1,.3700E-1,.4990E-1,    DAH20
     1.7520E-3,.1830E-2,.4450E-2,.1000E-1,.1790E-1,.2580E-1,.4180E-1,    DAH20
     1.4290E-3,.1410E-2,.3540E-2,.7210E-2,.1490E-1,.2120E-1,.3480E-1,    DAH20
     1.3270E-3,.9320E-3,.2090E-2,.5880E-2,.1120E-1,.1720E-1,.2870E-1,    DAH20
     1.2250E-3,.6850E-3,.1890E-2,.5120E-2,.1010E-1,.1540E-1,.2350E-1,    DAH20
     1.1860E-3,.5510E-3,.1560E-2,.3660E-2,.8120E-2,.1360E-1,.1890E-1,    DAH20
     1.1730E-3,.1720E-3,.1390E-2,.3060E-2,.6610E-2,.1150E-1,.1500E-1/    DAH20
      DATA COEF10/                                                       DAH20
     1.1380E-3,.3950E-3,.1100E-2,.2720E-2,.5870E-2,.1040E-1,.1250E-1,    DAH20
     1.9000E-4,.2700E-3,.9680E-3,.2220E-2,.4970E-2,.9210E-2,.1190E-1,    DAH20
     1.7520E-4,.2330E-3,.7440E-3,.2080E-2,.4660E-2,.8760E-2,.1180E-1,    DAH20
     1.6180E-4,.1750E-3,.6380E-3,.1850E-2,.4650E-2,.9140E-2,.1230E-1,    DAH20
     1.5040E-4,.1340E-3,.4990E-3,.1740E-2,.4550E-2,.9350E-2,.1280E-1,    DAH20
     1.3750E-4,.1230E-3,.4850E-3,.1820E-2,.4560E-2,.9710E-2,.1340E-1,    DAH20
     1.3050E-4,.8920E-4,.3380E-3,.1340E-2,.4600E-2,.1040E-1,.1420E-1,    DAH20
     1.2570E-4,.7980E-4,.3290E-3,.1540E-2,.4770E-2,.1120E-1,.1510E-1,    DAH20
     1.2420E-4,.7400E-4,.3080E-3,.1350E-2,.4970E-2,.1220E-1,.1620E-1,    DAH20
     1.2150E-4,.6530E-4,.2820E-3,.1310E-2,.5210E-2,.1330E-1,.1730E-1,    DAH20
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     1.2180E-4,.6680E-4,.2720E-3,.1520E-2,.5730E-2,.1480E-1,.1870E-1,        DAH20   230
     1.2150E-4,.6710E-4,.2680E-3,.1340E-2,.6070E-2,.1590E-1,.2020E-1,        DAH20   231
     1.2170E-4,.6950E-4,.2850E-3,.1610E-2,.6770E-2,.1730E-1,.2230E-1,        DAH20   232
     1.2190E-4,.7220E-4,.2970E-3,.1690E-2,.7830E-2,.1970E-1,.2460E-1,        DAH20   233
     1.2260E-4,.7710E-4,.3410E-3,.2360E-2,.9250E-2,.2260E-1,.2700E-1,        DAH20   234
     1.2500E-4,.8150E-4,.3870E-3,.2860E-2,.1060E-1,.2500E-1,.3000E-1,        DAH20   235
     1.2800E-4,.8450E-4,.4200E-3,.3570E-2,.1240E-1,.2760E-1,.3380E-1,        DAH20   236
     1.3510E-4,.1920E-3,.4700E-3,.4670E-2,.1660E-1,.3130E-1,.3700E-1,        DAH20   237
     1.4350E-4,.2600E-3,.1050E-2,.5660E-2,.1850E-1,.3410E-1,.3990E-1/        DAH20   238
      DATA COEF11/                                                           DAH20   239
     1.5220E-4,.2330E-3,.1290E-2,.7360E-2,.2290E-1,.3780E-1,.4220E-1,        DAH20   240
     1.6730E-4,.3060E-3,.1830E-2,.9820E-2,.2590E-1,.4040E-1,.4400E-1,        DAH20   241
     1.8850E-4,.3990E-3,.2460E-2,.1280E-1,.3020E-1,.4300E-1,.4560E-1,        DAH20   242
     1.1130E-3,.6190E-3,.3460E-2,.1610E-1,.3580E-1,.4590E-1,.4650E-1,        DAH20   243
     1.1740E-3,.8250E-3,.4410E-2,.2000E-1,.4170E-1,.4930E-1,.4730E-1,        DAH20   244
     1.2650E-3,.1630E-2,.7770E-2,.2450E-1,.4830E-1,.5070E-1,.4780E-1,        DAH20   245
     1.3550E-3,.2080E-2,.9780E-2,.3170E-1,.4920E-1,.5270E-1,.4780E-1,        DAH20   246
     1.5390E-3,.2710E-2,.1670E-1,.4010E-1,.5030E-1,.5230E-1,.4730E-1,        DAH20   247
     1.6510E-3,.3010E-2,.2640E-1,.4670E-1,.5200E-1,.5260E-1,.4600E-1,        DAH20   248
     1.9870E-3,.5300E-2,.3210E-1,.4990E-1,.5230E-1,.5100E-1,.4470E-1,        DAH20   249
     1.1350E-2,.9500E-2,.3890E-1,.5280E-1,.5130E-1,.4920E-1,.4300E-1,        DAH20   250
     1.2260E-2,.1300E-1,.4720E-1,.5590E-1,.5000E-1,.4690E-1,.4150E-1,        DAH20   251
     1.4310E-2,.1980E-1,.5260E-1,.5570E-1,.4830E-1,.4520E-1,.4000E-1,        DAH20   252
     1.6280E-2,.2820E-1,.4890E-1,.4950E-1,.4510E-1,.4300E-1,.3900E-1,        DAH20   253
     1.9000E-2,.3900E-1,.4710E-1,.4490E-1,.4300E-1,.4230E-1,.3850E-1,        DAH20   254
     1.1300E-1,.4620E-1,.4120E-1,.3910E-1,.4030E-1,.4150E-1,.3930E-1,        DAH20   255
     1.3400E-1,.7100E-1,.4020E-1,.3600E-1,.3840E-1,.4140E-1,.4050E-1,        DAH20   256
     1.7180E-1,.5900E-1,.3990E-1,.3600E-1,.3760E-1,.4200E-1,.4180E-1,        DAH20   257
     1.1110E-0,.3680E-1,.3400E-1,.3690E-1,.4090E-1,.4540E-1,.4340E-1/        DAH20   258
      DATA COEF12/                                                           DAH20   259
     1.3290E-1,.2850E-1,.3650E-1,.4230E-1,.4610E-1,.4820E-1,.4500E-1,        DAH20   260
     1.2810E-1,.2700E-1,.4320E-1,.5050E-1,.5290E-1,.5110E-1,.4620E-1,        DAH20   261
     1.1210E-0,.4220E-1,.5090E-1,.5980E-1,.5720E-1,.5440E-1,.4700E-1,        DAH20   262
     1.1390E-0,.1050E-0,.8440E-1,.6870E-1,.5930E-1,.5600E-1,.4800E-1,        DAH20   263
     1.7740E-1,.7100E-1,.6830E-1,.6180E-1,.5560E-1,.5340E-1,.4780E-1,        DAH20   264
     1.3540E-1,.4930E-1,.5790E-1,.5470E-1,.5030E-1,.4950E-1,.4600E-1,        DAH20   265
     1.9850E-1,.5750E-1,.5890E-1,.5100E-1,.4510E-1,.4490E-1,.4250E-1,        DAH20   266
     1.9360E-1,.6320E-1,.5390E-1,.4890E-1,.4540E-1,.4460E-1,.4000E-1,        DAH20   267
     1.6800E-1,.6800E-1,.5480E-1,.4950E-1,.4600E-1,.4580E-1,.4050E-1,        DAH20   268
     1.3250E-1,.5200E-1,.5150E-1,.4830E-1,.4490E-1,.4540E-1,.4180E-1,        DAH20   269
     1.1500E-1,.3500E-1,.4510E-1,.4640E-1,.4520E-1,.4490E-1,.4380E-1,        DAH20   270
     1.6200E-2,.2380E-1,.3690E-1,.4080E-1,.4140E-1,.4170E-1,.4200E-1,        DAH20   271
     1.2700E-2,.1580E-1,.2820E-1,.3390E-1,.3660E-1,.3840E-1,.4000E-1,        DAH20   272
     1.1130E-2,.1010E-1,.2030E-1,.2630E-1,.3030E-1,.3330E-1,.3600E-1,        DAH20   273
     1.6290E-3,.5900E-2,.1480E-1,.2060E-1,.2470E-1,.2950E-1,.3200E-1,        DAH20   274
     1.3650E-3,.3100E-2,.9890E-2,.1540E-1,.2030E-1,.2580E-1,.2800E-1,        DAH20   275
     1.2480E-3,.1380E-2,.5890E-2,.1120E-1,.1840E-1,.2220E-1,.2500E-1,        DAH20   276
     1.1590E-3,.4000E-3,.4170E-2,.8500E-2,.1340E-1,.1900E-1,.2200E-1,        DAH20   277
     1.1030E-3,.2620E-3,.2080E-2,.5940E-2,.1090E-1,.1620E-1,.1900E-1/        DAH20   278
      DATA COEF13/                                                           DAH20   279
     1.7410E-4,.1810E-3,.1420E-2,.4550E-2,.9070E-2,.1410E-1,.1700E-1,        DAH20   280
     1.6250E-4,.1350E-3,.8160E-3,.3160E-2,.6980E-2,.1210E-1,.1500E-1,        DAH20   281
     1.4990E-4,.1110E-3,.6240E-3,.2300E-2,.5510E-2,.1020E-1,.1300E-1,        DAH20   282
     1.3250E-4,.6770E-4,.4250E-3,.1240E-2,.3850E-2,.8180E-2,.1200E-1,        DAH20   283
     1.2310E-4,.5630E-4,.2780E-3,.9860E-3,.2900E-2,.6720E-2,.1050E-1,        DAH20   284
     1.1650E-4,.4810E-4,.2470E-3,.9440E-3,.2530E-2,.6120E-2,.9800E-2,        DAH20   285
     1.1250E-4,.4320E-4,.2410E-3,.8860E-3,.2200E-2,.5820E-2,.9400E-2,        DAH20   286
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1.1180E-4,.4200E-4,.2350E-3,.8470E-3,.2890E-2,.5710E-2,.9300E-2,       DAH20
1.1180E-4,.4000E-4,.2260E-3,.8120E-3,.2210E-2,.6840E-2,.9250E-2,       DAH20
1.1010E-4,.4000E-4,.2130E-3,.8050E-3,.2390E-2,.6410E-2,.9300E-2,       DAH20
1.9830E-5,.3950E-4,.1850E-3,.8610E-3,.2470E-2,.6910E-2,.9570E-2,       DAH20
1.9790E-5,.4010E-4,.1930E-3,.8050E-3,.2600E-2,.7320E-2,.9700E-2,       DAH20
1.9760E-5,.4100E-4,.2010E-3,.8140E-3,.2850E-2,.7760E-2,.1000E-1,       DAH20
1.9680E-5,.4230E-4,.2100E-3,.8320E-3,.3170E-2,.8420E-2,.1030E-1,       DAH20
1.9910E-5,.4250E-4,.2190E-3,.8770E-3,.3400E-2,.8880E-2,.1050E-1,       DAH20
1.1020E-4,.4350E-4,.2310E-3,.9370E-3,.3610E-2,.9290E-2,.1100E-1,       DAH20
1.1100E-4,.4860E-4,.2440E-3,.9710E-3,.4020E-2,.9940E-2,.1130E-1,       DAH20
1.1270E-4,.5790E-4,.2570E-3,.1110E-2,.4370E-2,.1040E-1,.1190E-1,       DAH20
1.1310E-4,.6120E-4,.2770E-3,.1130E-2,.4650E-2,.1100E-1,.1250E-1/       DAH20
 DATA COEF14/                                                          DAH20
1.1530E-4,.7830E-4,.3530E-3,.1160E-2,.5100E-2,.1160E-1,.1300E-1,       DAH20
1.1780E-4,.9220E-4,.3940E-3,.1570E-2,.5550E-2,.1230E-1,.1350E-1,       DAH20
1.2030E-4,.1150E-3,.4810E-3,.1850E-2,.6010E-2,.1310E-1,.1430E-1,       DAH20
1.2300E-4,.1450E-3,.6170E-3,.1830E-2,.6440E-2,.1390E-1,.1500E-1,       DAH20
1.2800E-4,.1170E-3,.7230E-3,.2620E-2,.5860E-2,.1450E-1,.1570E-1,       DAH20
1.3050E-4,.2090E-3,.8110E-3,.2430E-2,.7790E-2,.1570E-1,.1640E-1,       DAH20
1.4550E-4,.2440E-3,.9350E-3,.2430E-2,.8440E-2,.1660E-1,.1720E-1,       DAH20
1.6510E-4,.3200E-3,.9890E-3,.2880E-2,.9020E-2,.1730E-1,.1800E-1,       DAH20
1.7230E-4,.3970E-3,.1220E-2,.3590E-2,.1000E-1,.1840E-1,.1910E-1,       DAH20
1.8470E-4,.4810E-3,.1430E-2,.4290E-2,.1080E-1,.1920E-1,.2000E-1,       DAH20
1.1130E-3,.5910E-3,.1740E-2,.4860E-2,.1160E-1,.2000E-1,.2110E-1,       DAH20
1.1310E-3,.7030E-3,.2170E-2,.5490E-2,.1240E-1,.2050E-1,.2220E-1,       DAH20
1.1650E-3,.8720E-3,.2650E-2,.6410E-2,.1310E-1,.2110E-1,.2330E-1,       DAH20
1.2050E-3,.1100E-2,.2990E-2,.7490E-2,.1400E-1,.2180E-1,.2440E-1,       DAH20
1.2530E-3,.1300E-2,.3460E-2,.8110E-2,.1530E-1,.2330E-1,.2550E-1,       DAH20
1.3380E-3,.1500E-2,.4450E-2,.8920E-2,.1590E-1,.2370E-1,.2670E-1,       DAH20
1.4370E-3,.1700E-2,.4910E-2,.1070E-1,.1700E-1,.2450E-1,.2750E-1,       DAH20
1.5810E-3,.1900E-2,.5370E-2,.1160E-1,.1790E-1,.2540E-1,.2870E-1,       DAH20
1.6650E-3,.2200E-2,.5780E-2,.1280E-1,.1890E-1,.2630E-1,.2960E-1/       DAH20
 DATA COEF15/                                                          DAH20
1.9000E-3,.2500E-2,.6490E-2,.1340E-1,.1950E-1,.2750E-1,.3050E-1,       DAH20
1.1210E-2,.2800E-2,.7220E-2,.1420E-1,.2020E-1,.2810E-1,.3130E-1,       DAH20
1.1520E-2,.3310E-2,.8130E-2,.1610E-1,.2120E-1,.2880E-1,.3200E-1,       DAH20
1.1850E-2,.3700E-2,.9070E-2,.1680E-1,.2220E-1,.2920E-1,.3290E-1,       DAH20
1.2200E-2,.4300E-2,.9290E-2,.1830E-1,.2330E-1,.2940E-1,.3350E-1,       DAH20
1.2550E-2,.5000E-2,.1140E-1,.1950E-1,.2450E-1,.2890E-1,.3390E-1,       DAH20
1.2900E-2,.5800E-2,.1670E-1,.2150E-1,.2600E-1,.2910E-1,.3430E-1,       DAH20
1.3200E-2,.6700E-2,.2080E-1,.2370E-1,.2740E-1,.2930E-1,.3450E-1,       DAH20
1.3500E-2,.8800E-2,.2200E-1,.2530E-1,.2820E-1,.3000E-1,.3430E-1,       DAH20
1.4300E-2,.9200E-2,.2380E-1,.2730E-1,.2500E-1,.3040E-1,.3410E-1,       DAH20
1.4500E-2,.1080E-1,.2720E-1,.2790E-1,.2980E-1,.3100E-1,.3390E-1,       DAH20
1.5300E-2,.1280E-1,.3040E-1,.2920E-1,.2970E-1,.3120E-1,.3330E-1,       DAH20
1.6200E-2,.1520E-1,.3440E-1,.3030E-1,.2930E-1,.3100E-1,.3250E-1,       DAH20
1.7600E-2,.1820E-1,.3410E-1,.2970E-1,.2900E-1,.3000E-1,.3130E-1,       DAH20
1.9800E-2,.2220E-1,.3980E-1,.3180E-1,.2910E-1,.2940E-1,.2990E-1,       DAH20
1.1320E-1,.2710E-1,.4020E-1,.2940E-1,.2740E-1,.2820E-1,.2830E-1,       DAH20
1.1900E-1,.3350E-1,.4210E-1,.2860E-1,.2620E-1,.2690E-1,.2630E-1,       DAH20
1.2400E-1,.4320E-1,.4310E-1,.2760E-1,.2450E-1,.2570E-1,.2430E-1,       DAH20
1.2580E-1,.5700E-1,.4580E-1,.2700E-1,.2280E-1,.2430E-1,.2230E-1/       DAH20
 DATA COEF16/                                                          DAH20
1.3230E-1,.7420E-1,.4490E-1,.2610E-1,.2140E-1,.2210E-1,.2060E-1,       DAH20
1.5700E-1,.8900E-1,.4350E-1,.2550E-1,.1990E-1,.1990E-1,.1990E-1,       DAH20
1.2160E-1,.6830E-1,.3780E-1,.2390E-1,.1950E-1,.1920E-1,.1900E-1,       DAH20
1.1260E-1,.4750E-1,.3040E-1,.2380E-1,.1970E-1,.1920E-1,.1870E-1,       DAH20
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1.1175E-1,.3690E-1,.3850E-1,.2490E-1,.2120E-1,.2040E-1,.2000E-1,     DAH20     344
1.1400E-1,.3700E-1,.4190E-1,.2720E-1,.2280E-1,.2130E-1,.2240E-1,     DAH20     345
1.4250E-1,.4180E-1,.4480E-1,.2800E-1,.2480E-1,.2290E-1,.2430E-1,     DAH20     346
1.6400E-1,.4600E-1,.4270E-1,.2500E-1,.2630E-1,.2380E-1,.2600E-1,     DAH20     347
1.3850E-1,.3850E-1,.3740E-1,.2590E-1,.2350E-1,.2240E-1,.2600E-1,     DAH20     348
1.1820E-1,.1790E-1,.2820E-1,.2310E-1,.2110E-1,.2140E-1,.2400E-1,     DAH20     349
1.1700E-1,.8100E-2,.1910E-1,.1750E-1,.1810E-1,.1340E-1,.2100E-1,     DAH20     350
1.1510E-1,.3700E-2,.1050E-1,.1270E-1,.1520E-1,.1710E-1,.1800E-1,     DAH20     351
1.1450E-1,.1700E-2,.5540E-2,.8550E-2,.1130E-1,.1310E-1,.1500E-1,     DAH20     352
1.1750E-2,.1450E-2,.3850E-2,.5950E-2,.6030E-2,.9450E-2,.1200E-1,     DAH20     353
1.7720E-3,.7510E-3,.3840E-2,.5750E-2,.5370E-2,.5940E-2,.8000E-2,     DAH20     354
1.4310E-3,.6030E-3,.3010E-2,.4530E-2,.3800E-2,.4340E-2,.6000E-2,     DAH20     355
1.2750E-3,.4100E-3,.1930E-2,.3660E-2,.3190E-2,.3320E-2,.5000E-2,     DAH20     356
1.1850E-3,.2800E-3,.1310E-2,.2320E-2,.2470E-2,.2560E-2,.4200E-2,     DAH20     357
1.1010E-3,.1600E-3,.9150E-3,.1500E-2,.1860E-2,.1970E-2,.3700E-2/     DAH20     358
 DATA COEF17/                                                        DAH20     359
1.6910E-4,.1100E-3,.5650E-3,.1140E-2,.2050E-2,.1920E-2,.3400E-2,     DAH20     360
1.4760E-4,.7500E-4,.1145E-2,.1240E-2,.1750E-2,.1870E-2,.3200E-2,     DAH20     361
1.3350E-4,.5900E-4,.5290E-3,.1140E-2,.1600E-2,.1850E-2,.3000E-2,     DAH20     362
1.2400E-4,.4900E-4,.2530E-3,.8420E-3,.1410E-2,.1840E-2,.2900E-2,     DAH20     363
1.1700E-4,.3600E-4,.1220E-3,.4350E-3,.1240E-2,.1820E-2,.2900E-2,     DAH20     364
1.1200E-4,.2400E-4,.1210E-3,.4350E-3,.1180E-2,.1870E-2,.2910E-2,     DAH20     365
1.8100E-5,.1700E-4,.1030E-3,.4390E-3,.1260E-2,.1920E-2,.2950E-2,     DAH20     366
1.5500E-5,.1200E-4,.6660E-4,.3670E-3,.1190E-2,.1930E-2,.3000E-2,     DAH20     367
1.3900E-5,.9000E-5,.7160E-4,.3510E-3,.1160E-2,.1940E-2,.3030E-2,     DAH20     368
1.2950E-5,.8300E-5,.3730E-4,.2540E-3,.1140E-2,.1960E-2,.3100E-2,     DAH20     369
1.2300E-5,.8000E-5,.4650E-4,.2980E-3,.1170E-2,.2010E-2,.3200E-2,     DAH20     370
1.2250E-5,.8200E-5,.3670E-4,.2520E-3,.1160E-2,.2350E-2,.3300E-2,     DAH20     371
1.2200E-5,.8400E-5,.3710E-4,.2680E-3,.1270E-2,.2110E-2,.3400E-2,     DAH20     372
1.2230E-5,.9200E-5,.3960E-4,.2730E-3,.1280E-2,.2160E-2,.3550E-2,     DAH20     373
1.2350E-5,.1830E-4,.4150E-4,.2630E-3,.1210E-2,.2210E-2,.3650E-2,     DAH20     374
1.2800E-5,.1250E-4,.6330E-4,.3630E-3,.1360E-2,.2310E-2,.3800E-2,     DAH20     375
1.3100E-5,.1500E-4,.9790E-4,.4920E-3,.1500E-2,.2410E-2,.4000E-2,     DAH20     376
1.3700E-5,.1800E-4,.1200E-3,.5400E-3,.1670E-2,.2510E-2,.4100E-2,     DAH20     377
1.4200E-5,.2000E-4,.9870E-4,.5890E-3,.1710E-2,.2570E-2,.4200E-2/     DAH20     378
 DATA COEF18/                                                        DAH20     379
1.5100E-5,.2400E-4,.1340E-3,.5470E-3,.1730E-2,.2670E-2,.4400E-2,     DAH20     380
1.6300E-5,.2700E-4,.1210E-3,.5340E-3,.1720E-2,.2740E-2,.4570E-2,     DAH20     381
1.7200E-5,.3000E-4,.2040E-3,.6840E-3,.1840E-2,.2850E-2,.4680E-2,     DAH20     382
1.9280E-5,.3300E-4,.2760E-3,.8190E-3,.1990E-2,.2970E-2,.4790E-2,     DAH20     383
1.1100E-4,.3830E-4,.3170E-3,.8590E-3,.2140E-2,.3080E-2,.4850E-2,     DAH20     384
1.1250E-4,.4200E-4,.2400E-3,.8180E-3,.2200E-2,.3170E-2,.4900E-2,     DAH20     385
1.1450E-4,.5000E-4,.4520E-3,.1090E-2,.2380E-2,.2930E-2,.4990E-2,     DAH20     386
1.1750E-4,.5600E-4,.3010E-3,.9410E-3,.2430E-2,.3420E-2,.5000E-2,     DAH20     387
1.1980E-4,.6300E-4,.2800E-3,.1070E-2,.2600E-2,.3530E-2,.5010E-2,     DAH20     388
1.2300E-4,.7100E-4,.2760E-3,.1090E-2,.2720E-2,.3650E-2,.5020E-2,     DAH20     389
1.2600E-4,.8300E-4,.3690E-3,.1270E-2,.2950E-2,.3770E-2,.5010E-2,     DAH20     390
1.3300E-4,.8900E-4,.4300E-3,.1390E-2,.3060E-2,.3850E-2,.5000E-2,     DAH20     391
1.3600E-4,.9500E-4,.3710E-3,.1350E-2,.3060E-2,.3840E-2,.4990E-2,     DAH20     392
1.3900E-4,.9800E-4,.4340E-3,.1470E-2,.3160E-2,.3850E-2,.4950E-2,     DAH20     393
1.4300E-4,.9900E-4,.3970E-3,.1430E-2,.3180E-2,.3840E-2,.4900E-2,     DAH20     394
1.4300E-4,.9800E-4,.3640E-3,.1410E-2,.3170E-2,.3810E-2,.4800E-2,     DAH20     395
1.3900E-4,.9400E-4,.3900E-3,.1420E-2,.3140E-2,.3760E-2,.4750E-2,     DAH20     396
1.3800E-4,.9000E-4,.3800E-3,.1450E-2,.3180E-2,.3750E-2,.4630E-2,     DAH20     397
1.3300E-4,.7500E-4,.3580E-3,.1380E-2,.3100E-2,.3720E-2,.4550E-2/     DAH20     398
 DATA COEF19/                                                        DAH20     399
1.3300E-4,.6500E-4,.3430E-3,.1360E-2,.3090E-2,.3690E-2,.4430E-2,     DAH20     400
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     1.2700E-4,.5830E-4,.3020E-3,.1430E-2,.2250E-2,.3590E-2,.4330E-2,     DAH20   401
     1.2400E-4,.5000E-4,.3430E-3,.1360E-2,.3060E-2,.3630E-2,.4200E-2,     DAH20   402
     1.2000E-4,.4500E-4,.3090E-3,.1340E-2,.3060E-2,.3590E-2,.4080E-2,     DAH20   403
     1.1800E-4,.4000E-4,.2810E-3,.1270E-2,.2940E-2,.3410E-2,.3950E-2,     DAH20   404
     1.1700E-4,.3600E-4,.2760E-3,.1240E-2,.2900E-2,.3380E-2,.3800E-2,     DAH20   405
     1.1600E-4,.3100E-4,.2720E-3,.1220E-2,.2830E-2,.3230E-2,.3670E-2,     DAH20   406
     1.1400E-4,.2800E-4,.2410E-3,.1170E-2,.2730E-2,.3090E-2,.3510E-2,     DAH20   407
     1.1200E-4,.2500E-4,.2370E-3,.1150E-2,.2690E-2,.2970E-2,.3390E-2,     DAH20   408
     1.1000E-4,.2200E-4,.2180E-3,.1110E-2,.2590E-2,.2860E-2,.3230E-2,     DAH20   409
     1.9200E-5,.1990E-4,.2060E-3,.1650E-2,.2460E-2,.2690E-2,.3100E-2,     DAH20   410
     1.6100E-5,.1700E-4,.2650E-3,.1000E-2,.2350E-2,.2570E-2,.2950E-2,     DAH20   411
     1.7200E-5,.1590E-4,.1770E-3,.9210E-3,.2200E-2,.2450E-2,.2800E-2,     DAH20   412
     1.6500E-5,.1530E-4,.1720E-3,.8540E-3,.2050E-2,.2320E-2,.2680E-2,     DAH20   413
     1.5900E-5,.1300E-4,.1470E-3,.7250E-3,.1940E-2,.2100E-2,.2530E-2,     DAH20   414
     1.5100E-5,.1130E-4,.1200E-3,.6290E-3,.1770E-2,.2030E-2,.2400E-2,     DAH20   415
     1.4600E-5,.9500E-5,.9800E-4,.5130E-3,.1540E-2,.1850E-2,.2390E-2,     DAH20   416
     1.4200E-5,.9000E-5,.5780E-4,.3140E-3,.1230E-2,.1560E-2,.2180E-2,     DAH20   417
     1.3800E-5,.7200E-5,.5290E-4,.2920E-3,.1141E-2,.1370E-2,.2070E-2/     DAH20   418
      DATA COEF20/                                                        DAH20   419
     1.3300E-5,.6600E-5,.4650E-4,.2690E-3,.1020E-2,.1220E-2,.1970E-2,     DAH20   420
     1.2900E-5,.5800E-5,.4300E-4,.2390E-3,.8960E-3,.1070E-2,.1970E-2,     DAH20   421
     1.2700E-5,.5200E-5,.2590E-4,.1930E-3,.7840E-3,.9440E-3,.1790E-2,     DAH20   422
     1.2400E-5,.4500E-5,.3960E-4,.2070E-3,.6710E-3,.8180E-3,.1710E-2,     DAH20   423
     1.2200E-5,.4000E-5,.4440E-5,.6620E-4,.5150E-3,.7500E-3,.1630E-2,     DAH20   424
     1.1900E-5,.3600E-5,.3240E-5,.4660E-4,.4390E-3,.6800E-3,.1560E-2,     DAH20   425
     1.1700E-5,.3200E-5,.1000E-5,.3210E-4,.3840E-3,.6530E-3,.1490E-2,     DAH20   426
     1.1400E-5,.2800E-5,.1710E-5,.3440E-4,.3400E-3,.6160E-3,.1430E-2,     DAH20   427
     1.1300E-5,.2550E-5,.2990E-5,.6600E-4,.3430E-3,.6190E-3,.1380E-2,     DAH20   428
     1.1200E-5,.2200E-5,.2590E-5,.6600E-4,.3430E-3,.6190E-3,.1330E-2,     DAH20   429
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.5100E-3,.9100E-3,.1300E-2,     DAH20   430
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.5300E-3,.9800E-3,.1270E-2,     DAH20   431
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.5500E-3,.9100E-3,.1260E-2,     DAH20   432
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.5600E-3,.9100E-3,.1250E-2,     DAH20   433
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.5900E-3,.9200E-3,.1240E-2,     DAH20   434
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.6100E-3,.9300E-3,.1240E-2,     DAH20   435
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.6400E-3,.9400E-3,.1250E-2,     DAH20   436
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.6600E-3,.9600E-3,.1260E-2,     DAH20   437
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.6900E-3,.9500E-3,.1270E-2/     DAH20   438
      DATA COEF21/                                                        DAH20   439
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.7200E-3,.1000E-2,.1280E-2,     DAH20   440
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.7500E-3,.1020E-2,.1290E-2,     DAH20   441
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.7900E-3,.1040E-2,.1300E-2,     DAH20   442
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.8200E-3,.1070E-2,.1320E-2,     DAH20   443
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.8600E-3,.1100E-2,.1330E-2,     DAH20   444
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.9000E-3,.1130E-2,.1350E-2,     DAH20   445
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.9400E-3,.1160E-2,.1370E-2,     DAH20   446
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.9800E-3,.1190E-2,.1390E-2,     DAH20   447
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.1020E-2,.1210E-2,.1400E-2,     DAH20   448
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.1060E-2,.1240E-2,.1420E-2,     DAH20   449
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.1100E-2,.1270E-2,.1440E-2,     DAH20   450
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.1130E-2,.1300E-2,.1470E-2,     DAH20   451
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.1180E-2,.1330E-2,.1480E-2,     DAH20   452
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.1220E-2,.1360E-2,.1500E-2,     DAH20   453
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.1260E-2,.1390E-2,.1520E-2,     DAH20   454
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.1300E-2,.1420E-2,.1540E-2,     DAH20   455
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.1330E-2,.1450E-2,.1570E-2,     DAH20   456
     1.   0E+0,,   0E+0,,   0E+0,,   0E+0,,.1370E-2,.1480E-2,.1590E-2,     DAH20   457
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      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1410E-2,.1510E-2,.1610E-2/      DAH20   458
       DATA COEF22/                                                     DAH20   459
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1440E-2,.1530E-2,.1610E-2,      DAH20   460
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1470E-2,.1540E-2,.1610E-2,      DAH20   461
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1500E-2,.1550E-2,.1600E-2,      DAH20   462
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1520E-2,.1560E-2,.1600E-2,      DAH20   463
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1560E-2,.1570E-2,.1580E-2,      DAH20   464
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1580E-2,.1570E-2,.1570E-2,      DAH20   465
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1570E-2,.1560E-2,.1540E-2,      DAH20   466
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1550E-2,.1530E-2,.1520E-2,      DAH20   467
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1530E-2,.1510E-2,.1490E-2,      DAH20   468
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1500E-2,.1480E-2,.1470E-2,      DAH20   469
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1470E-2,.1450E-2,.1430E-2,      DAH20   470
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1430E-2,.1420E-2,.1400E-2,      DAH20   471
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1390E-2,.1370E-2,.1370E-2,      DAH20   472
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1330E-2,.1330E-2,.1330E-2,      DAH20   473
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1250E-2,.1280E-2,.1310E-2,      DAH20   474
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1200E-2,.1260E-2,.1320E-2,      DAH20   475
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1210E-2,.1270E-2,.1330E-2,      DAH20   476
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1250E-2,.1310E-2,.1370E-2,      DAH20   477
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1280E-2,.1330E-2,.1330E-2/      DAH20   478
       DATA COEF23/                                                     DAH20   479
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1330E-2,.1370E-2,.1410E-2,      DAH20   480
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1370E-2,.1400E-2,.1430E-2,      DAH20   481
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1400E-2,.1420E-2,.1430E-2,      DAH20   482
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1410E-2,.1410E-2,.1420E-2,      DAH20   483
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1370E-2,.1370E-2,.1370E-2,      DAH20   484
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1280E-2,.1250E-2,.1230E-2,      DAH20   485
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.1100E-2,.1090E-2,.1080E-2,      DAH20   486
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.9500E-3,.9600E-3,.9600E-3,      DAH20   487
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.8200E-3,.8300E-3,.8400E-3,      DAH20   488
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.6900E-3,.7800E-3,.7200E-3,      DAH20   489
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.5400E-3,.5800E-3,.6200E-3,      DAH20   490
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.4100E-3,.4700E-3,.5200E-3,      DAH20   491
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.3200E-3,.3500E-3,.4300E-3,      DAH20   492
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.2900E-3,.3400E-3,.3900E-3,      DAH20   493
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.2800E-3,.3200E-3,.3600E-3,      DAH20   494
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.2700E-3,.3100E-3,.3400E-3,      DAH20   495
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.2700E-3,.3000E-3,.3200E-3,      DAH20   496
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.2600E-3,.2900E-3,.3100E-3,      DAH20   497
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.2600E-3,.2800E-3,.2900E-3/      DAH20   498
       DATA COEF24/                                                     DAH20   499
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.2500E-3,.2700E-3,.2800E-3,      DAH20   500
      1.,  0E+0,   0E+0,   0E+0,   0E+0,.2500E-3,.2500E-3,.2600E-3/      DAH20   501
       DATA COEF25/                                                     DAH20   502
     *.3315E+0,.3969E+0,.6689E+0,.1347E+1,.2512E+1,.4127E+1,.5851E+1,    DAH20   503
     *.3324E+0,.3979E+0,.6797E+0,.1351E+1,.2518E+1,.4138E+1,.5864E+1,    DAH20   504
     *.3355E+0,.4015E+0,.6766E+0,.1363E+1,.2541E+1,.4175E+1,.5919E+1,    DAH20   505
     *.3407E+0,.4077E+0,.6871E+0,.1384E+1,.2580E+1,.4240E+1,.6012E+1,    DAH20   506
     *.3480E+0,.4166E+0,.7021E+0,.1414E+1,.2637E+1,.4331E+1,.6142E+1,    DAH20   507
     *.3579E+0,.4282E+0,.7217E+0,.1454E+1,.2710E+1,.4453E+1,.6311E+1,    DAH20   508
     *.3700E+0,.4428E+0,.7462E+0,.1503E+1,.2802E+1,.4604E+1,.6527E+1,    DAH20   509
     *.3847E+0,.4603E+0,.7758E+0,.1563E+1,.2913E+1,.4786E+1,.6784E+1,    DAH20   510
     *.4018E+0,.4810E+0,.8109E+0,.1633E+1,.3045E+1,.5000E+1,.7092E+1,    DAH20   511
     *.4219E+0,.5052E+0,.8515E+0,.1715E+1,.3198E+1,.5254E+1,.7447E+1,    DAH20   512
     *.4451E+0,.5329E+0,.8981E+0,.1810E+1,.3373E+1,.5543E+1,.7856E+1,    DAH20   513
     *.4717E+0,.5646E+0,.9515E+0,.1917E+1,.3573E+1,.5870E+1,.8321E+1,    DAH20   514
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*,.5414E+0,.6082E+2,.1011E+1,.2837E+1,.3798E+1,.6241E+1,.804 E+1      DAH20   515
*,.5347E+0,.6398E+0,.1079E+1,.2173E+1,.4052E+1,.6652E+1,.943 E+1      DAH20   516
*,.571 E+0,.6841E+0,.1153E+1,.2323E+1,.4325E+1,.7111E+1,.1008E+2      DAH20   517
*,.612 E+0,.7328E+0,.1235E+1,.2488E+1,.4638E+1,.7620E+1,.1091E+2      DAH20   518
*,.656 E+0,.7861E+0,.1325E+1,.2669E+1,.4975E+1,.8172E+1,.1159E+2      DAH20   519
*,.7051E+0,.8439E+0,.1423E+1,.2865E+1,.5342E+1,.8772E+1,.1244E+2      DAH20   520
*,.757 E+0,.9068E+0,.1528E+1,.3078E+1,.5737E+1,.9428E+1,.1337E+2      DAH20   521
 DATA COEF26/                                                         DAH20   522
*,.9133E+0,.5734E+0,.1640E+1,.3305E+1,.6162E+1,.1012E+2,.1435E+2      DAH20   523
*,.8726E+0,.1044E+1,.1760E+1,.3548E+1,.6608E+1,.1086E+2,.1540E+2      DAH20   524
*,.934 E+0,.1119E+1,.1886E+1,.3799E+1,.7082E+1,.1163E+2,.1649E+2      DAH20   525
*,.995 E+0,.1196E+1,.2015E+1,.4062E+1,.7569E+1,.1244E+2,.1764E+2      DAH20   526
*,.1065E+1,.1276E+1,.2151E+1,.4332E+1,.8073E+1,.1327E+2,.1881E+2      DAH20   527
*,.1133E+1,.1357E+1,.2287E+1,.4607E+1,.8589E+1,.1411E+2,.2001E+2      DAH20   528
*,.1201E+1,.1438E+1,.2424E+1,.4882E+1,.9098E+1,.1495E+2,.2120E+2,     DAH20   529
*,.1268E+1,.1519E+1,.2558E+1,.5153E+1,.9603E+1,.1578E+2,.2237E+2      DAH20   530
*,.1332E+1,.1595E+1,.2687E+1,.5414E+1,.1009E+2,.1658E+2,.2351E+2      DAH20   531
*,.1393E+1,.1667E+1,.2813E+1,.5661E+1,.1055E+2,.173 E+2,.2458E+2,     DAH20   532
*,.144 E+1,.1734E+1,.2924E+1,.5890E+1,.1098E+2,.1804E+2,.2557E+2,     DAH20   533
*,.1497E+1,.1795E+1,.3025E+1,.6093E+1,.1136E+2,.1865E+2,.2644E+2,     DAH20   534
*,.1542E+1,.1846E+1,.3111E+1,.6267E+1,.1168E+2,.1919E+2,.2720E+2      DAH20   535
*,.1577E+1,.1887E+1,.3181E+1,.6408E+1,.1194E+2,.1962E+2,.2782E+2      DAH20   536
*,.160 E+1,.1918E+1,.3233E+1,.6511E+1,.1214E+2,.1994E+2,.2827E+2,     DAH20   537
*,.1613E+1,.1936E+1,.3264E+1,.6575E+1,.1225E+2,.2014E+2,.2855E+2,     DAH20   538
*,.1623E+1,.1943E+1,.3275E+1,.6595E+1,.1229E+2,.2020E+2,.2864E+2      DAH20   539
*,.1619E+1,.1936E+1,.3264E+1,.6575E+1,.1225E+2,.2014E+2,.2855E+2,     DAH20   540
*,.1602E+1,.1918E+1,.3233E+1,.6512E+1,.1214E+2,.1995E+2,.2828E+2      DAH20   541
 DATA COEF27/                                                         DAH20   542
*,.1577E+1,.1899E+1,.3182E+1,.6439E+1,.1195E+2,.1963E+2,.2793E+2,     DAH20   543
*,.1543E+1,.1846E+1,.3112E+1,.6269E+1,.1168E+2,.1920E+2,.2722E+2,     DAH20   544
*,.1500E+1,.1795E+1,.3026E+1,.6096E+1,.1136E+2,.1867E+2,.2647E+2,     DAH20   545
*,.1450E+1,.1735E+1,.2925E+1,.5893E+1,.1099E+2,.1805E+2,.2559E+2,     DAH20   546
*,.135 E+1,.1649E+1,.2812E+1,.5666E+1,.1056E+2,.1735E+2,.2460E+2,     DAH20   547
*,.1333E+1,.1596E+1,.2690E+1,.5418E+1,.1010E+2,.1659E+2,.2352E+2,     DAH20   548
*,.1263E+1,.7197E+0,.1632E+1,.2181E+1,.6449E+1,.2160E+2,.8654E+2,     DAH20   549
*,.1202E+1,.5161E+0,.9355E+0,.1772E+1,.5498E+1,.1877E+2,.7519E+2,     DAH20   550
*,.1134E+1,.7115E+0,.9587E+0,.1988E+1,.6215E+1,.2067E+2,.8570E+2,     DAH20   551
*,.1067E+1,.7213E+0,.1018E+1,.2010E+1,.6273E+1,.2107E+2,.8570E+2,     DAH20   552
*,.1002E+1,.5377E+0,.8234E+0,.1772E+1,.5652E+1,.1926E+2,.7726E+2      DAH20   553
*,.9355E+0,.8147E+0,.8861E+0,.1742E+1,.4444E+1,.1398E+2,.5277E+2,     DAH20   554
*,.8732E+0,.4852E+0,.7530E+0,.1682E+1,.5329E+1,.1848E+2,.7430E+2,     DAH20   555
*,.8139E+0,.5918E+0,.9402E+0,.1705E+1,.5212E+1,.1735E+2,.6923E+2,     DAH20   556
*,.7580E+0,.7967E+0,.9966E+0,.1624E+1,.4696E+1,.1515E+2,.5784E+2,     DAH20   557
*,.7358E+0,.8627E+0,.9126E+0,.1779E+1,.4250E+1,.1168E+2,.3605E+2,     DAH20   558
*,.6572E+0,.7770E+0,.1005E+1,.1705E+1,.3559E+1,.7869E+1,.1832E+2,     DAH20   559
*,.6129E+0,.8311E+0,.1014E+1,.1556E+1,.2938E+1,.5376E+1,.1043E+2,     DAH20   560
*,.5719E+0,.4262E+0,.6742E+0,.1228E+1,.2691E+1,.4936E+1,.8232E+1/     DAH20   561
 DATA COEF28/                                                         DAH20   562
*,.5350E+0,.9049E+0,.9431E+0,.1303E+1,.2603E+1,.5914E+1,.1478E+2,     DAH20   563
*,.5017E+0,.1070E+1,.9147E+0,.1035E+1,.1454E+1,.2644E+1,.4897E+1,     DAH20   564
*,.4722E+0,.6180E+0,.8118E+0,.1355E+1,.2075E+1,.3705E+1,.5319E+1,     DAH20   565
*,.4455E+0,.6361E+0,.8765E+0,.1318E+1,.2158E+1,.3569E+1,.5193E+1,     DAH20   566
*,.4227E+0,.4541E+0,.7299E+0,.1548E+1,.2767E+1,.5083E+1,.8148E+1,     DAH20   567
*,.4021E+0,.5590E+0,.8202E+0,.1690E+1,.3852E+1,.1022E+2,.2664E+2,     DAH20   568
*,.3347E+0,.6459E+0,.1050E+1,.2293E+1,.3723E+1,.6647E+1,.1001E+2,     DAH20   569
*,.3700E+0,.6435E+0,.9580E+0,.1816E+1,.3471E+1,.5671E+1,.7952E+1,     DAH20   570
*,.357 E+0,.4223E+0,.747 E+0,.1608E+1,.3171E+1,.527 E+1,.7937E+1,     DAH20   571
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     *,.3083E+0,.5852E+0,.8520E+0,.1548E+1,.3890E+1,.5874E+1,.1847E+2,  DAH20  572
     *,.3087E+0,.3639E+0,.6182E+0,.1258E+1,.2779E+1,.6118E+1,.1186E+2,  DAH20  573
     *,.3355E+0,.5576E+0,.8339E+0,.1586E+1,.3131E+1,.6305E+1,.1165E+2,  DAH20  574
     *,.3324E+0,.6311E+0,.8139E+0,.1444E+1,.2820E+1,.6745E+1,.1554E+2,  DAH20  575
     *,.3315E+0,.7279E+0,.9630E+0,.1779E+1,.3782E+1,.9482E+1,.2461E+2,  DAH20  576
     *,.3327E+0,.5959E+0,.7961E+0,.1489E+1,.3225E+1,.8055E+1,.2077E+2,  DAH20  577
     *,.3361E+0,.7092E+0,.9221E+0,.1687E+1,.3596E+1,.9922E+1,.2377E+2,  DAH20  578
     *,.3419E+0,.3344E+0,.5671E+0,.1273E+1,.2896E+1,.7283E+1,.1516E+2,  DAH20  579
     *,.3495E+0,.3738E+0,.6165E+0,.1347E+1,.3148E+1,.7820E+1,.1727E+2,  DAH20  580
     *,.3591E+0,.5316E+0,.7278E+0,.1459E+1,.3172E+1,.6989E+1,.1752E+2/  DAH20  581
      DATA CFEI29/                                                      DAH20  582
     *,.3724E+0,.5797E+0,.8181E+0,.1556E+1,.3055E+1,.6598E+1,.1393E+2,  DAH20  583
     *,.3572E+0,.2538E+0,.4642E+0,.1117E+1,.2550E+1,.5425E+1,.1085E+2,  DAH20  584
     *,.4 [illegible]E+0,.2797E+0,.4684E+0,.1050E+1,.2291E+1,.4795E+1,.1030E+2,  DAH20  585
     *,.4262E+0,.3432E+0,.5209E+0,.1007E+1,.2111E+1,.4462E+1,.9936E+1,  DAH20  586
     *,.4503E+0,.3148E+0,.5083E+0,.1131E+1,.2353E+1,.4935E+1,.1102E+2,  DAH20  587
     *,.4769E+0,.3557E+0,.5787E+0,.1303E+1,.2621E+1,.5621E+1,.1186E+2,  DAH20  588
     *,.5072E+0,.4279E+0,.6028E+0,.1236E+1,.2421E+1,.6061E+1,.1469E+2,  DAH20  589
     *,.5411E+0,.6377E+0,.7173E+0,.1265E+1,.2134E+1,.5376E+1,.1511E+2,  DAH20  590
     *,.5797E+0,.6902E+0,.1344E+1,.2032E+1,.2932E+1,.8211E+1,.2761E+2,  DAH20  591
     *,.6227E+0,.7030E+0,.1061E+1,.1548E+1,.2351E+1,.7035E+1,.3727E+2,  DAH20  592
     *,.6654E+0,.7361E+0,.1145E+1,.1839E+1,.2861E+1,.9286E+1,.4939E+2,  DAH20  593
     *,.7143E+0,.7574E+0,.1197E+1,.1988E+1,.3119E+1,.1022E+2,.5277E+2,  DAH20  594
     *,.7673E+0,.7869E+0,.1218E+1,.2181E+1,.3406E+1,.1124E+2,.5615E+2,  DAH20  595
     *,.8243E+0,.8131E+0,.1260E+1,.2330E+1,.3717E+1,.1241E+2,.5953E+2,  DAH20  596
     *,.8839E+0,.8557E+0,.1302E+1,.2516E+1,.4051E+1,.1364E+2,.6375E+2,  DAH20  597
     *,.9465E+0,.8580E+0,.1344E+1,.2725E+1,.4427E+1,.1505E+2,.6797E+2,  DAH20  598
     *,.1012E+1,.8942E+0,.1386E+1,.2948E+1,.4925E+1,.1657E+2,.7219E+2,  DAH20  599
     *,.1079E+1,.9262E+0,.1433E+1,.3185E+1,.5265E+1,.1828E+2,.7683E+2,  DAH20  600
     *,.1146E+1,.9533E+0,.1481E+1,.3447E+1,.5746E+1,.2014E+2,.8190E+2/  DAH20  601
      DATA CFEF30/                                                      DAH20  602
     *,.1214E+1,.9859E+0,.1533E+1,.3729E+1,.6215E+1,.2219E+2,.8739E+2,  DAH20  603
     *,.1283E+1,.1025E+1,.1586E+1,.4035E+1,.6801E+1,.2444E+2,.9330E+2,  DAH20  604
     *,.1344E+1,.1059E+1,.1638E+1,.4370E+1,.7446E+1,.2588E+2,.9921E+2,  DAH20  605
     *,.1404E+1,.1095E+1,.1691E+1,.4727E+1,.8091E+1,.2957E+2,.1063E+3,  DAH20  606
     *,.1459E+1,.1131E+1,.1743E+1,.5107E+1,.8853E+1,.3265E+2,.1127E+3,  DAH20  607
     *,.1509E+1,.1177E+1,.1796E+1,.5531E+1,.9674E+1,.3597E+2,.1193E+3,  DAH20  608
     *,.1549E+1,.1135E+1,.1712E+1,.5263E+1,.9263E+1,.3392E+2,.1099E+3,  DAH20  609
     *,.1582E+1,.1036E+1,.1638E+1,.5010E+1,.8912E+1,.3197E+2,.1001E+3,  DAH20  610
     *,.1605E+1,.9705E+0,.1554E+1,.4772E+1,.8560E+1,.3011E+2,.9161E+2,  DAH20  611
     *,.1619E+1,.9115E+0,.1481E+1,.4541E+1,.8208E+1,.2840E+2,.8359E+2,  DAH20  612
     *,.1623E+1,.8557E+0,.1418E+1,.4318E+1,.7915E+1,.2574E+2,.7641E+2,  DAH20  613
     *,.1615E+1,.8316E+0,.1344E+1,.4117E+1,.7563E+1,.2522E+2,.6966E+2,  DAH20  614
     *,.1599E+1,.7721E+0,.1281E+1,.3915E+1,.7273E+1,.2375E+2,.6375E+2,  DAH20  615
     *,.1571E+1,.7443E+0,.1229E+1,.3729E+1,.[illegible]7E+1,.2239E+2,.5784E+2,  DAH20  616
     *,.1533E+1,.7180E+0,.1187E+1,.3551E+1,.6684E+1,.2111E+2,.5277E+2,  DAH20  617
     *,.1491E+1,.6918E+0,.1145E+1,.3380E+1,.6449E+1,.1989E+2,.4855E+2,  DAH20  618
     *,.1442E+1,.6705E+0,.1092E+1,.3216E+1,.6156E+1,.1872E+2,.4433E+2,  DAH20  619
     *,.1383E+1,.6443E+0,.1050E+1,.3059E+1,.5922E+1,.1764E+2,.4053E+2,  DAH20  620
     *,.1321E+1,.6229E+0,.1018E+1,.2911E+1,.5728E+1,.1667E+2,.3699E+2/  DAH20  621
      DATA CFEF31/                                                      DAH20  622
     *,.1255E+1,.6033E+0,.9767E+0,.2769E+1,.5499E+1,.1569E+2,.3377E+2,  DAH20  623
     *,.1191E+1,.5820E+0,.9399E+0,.2635E+1,.5282E+1,.1476E+2,.3082E+2,  DAH20  624
     *,.1122E+1,.5637E+0,.9074E+0,.2509E+1,.5071E+1,.1393E+2,.2816E+2,  DAH20  625
     *,.1054E+1,.5443E+0,.8782E+0,.2390E+1,.4872E+1,.1310E+2,.2571E+2,  DAH20  626
     *,.9891E+0,.5266E+0,.8654E+0,.2278E+1,.4679E+1,.1237E+2,.2347E+2,  DAH20  627
     *,.9230E+0,.5098E+0,.8255E+0,.2166E+1,.4491E+1,.1168E+2,.2145E+2,  DAH20  628
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     *,.6[illegible]E+0,.4426E+0,.7089E+0,.1690E+1,.3678E+1,.8651E+1,.1364E+2,  DAH20  633
     *,.5[illegible]E+0,.4295E+0,.6921E+0,.1615E+1,.3524E+1,.8162E+1,.1245E+2,  DAH20  634
     *,.5[illegible]E+0,.4180E+0,.6721E+0,.1533E+1,.3363E+1,.7574E+1,.1136E+2,  DAH20  635
     *,.52[illegible]E+0,.4082E+0,.6564E+0,.1459E+1,.3245E+1,.7234E+1,.1039E+2,  DAH20  636
     *,.4[illegible]E+0,.3984E+0,.5396E+0,.1511E+1,.2750E+1,.5328E+1,.1123E+2,  DAH20  637
     *,.4[illegible]E+0,.39[illegible]E+0,.62[illegible]E+0,.1504E+1,.2632E+1,.45[illegible]E+1,.96[illegible]E+1,  DAH20  638
     *,.4[illegible]E+0,.3503E+0,.6091E+0,.1422E+1,.2709E+1,.4721E+1,.73[illegible]E+1,  DAH20  639
     *,.4183E+0,.3739E+0,.5995E+0,.1370E+1,.2421E+1,.4296E+1,.7177E+1,  DAH20  640
     *,.3[illegible]E+0,.3539E+0,.5818E+0,.1243E+1,.2345E+1,.4198E+1,.5786E+1/  DAH20  641
      DATA COEF32/                                                      DAH20  642
     *,.3[illegible]E+0,.3557E+0,.5[illegible]E+0,.1280E+1,.2[illegible]E+1,.5110E+1,.5745E+1,  DAH20  643
     *,.3[illegible]E+0,.3508E+0,.559[illegible]E+0,.1184E+1,.2251E+1,.3993E+1,.5235E+1,  DAH20  644
     *,.3[illegible]E+0,.3410E+0,.5514E+0,.1184E+1,.2328E+1,.3719E+1,.4517E+1,  DAH20  645
     *,.3[illegible]E+0,.3361E+0,.5419E+0,.1090E+1,.1876E+1,.3274E+1,.4044E+1,  DAH20  646
     *,.3[illegible]E+0,.3205E+0,.5345E+0,.1050E+1,.1864E+1,.3143E+1,.4264E+1,  DAH20  647
     *,.3[illegible]E+0,.3252E+0,.5251E+0,.1132E+1,.2181E+1,.3348E+1,.4348E+1,  DAH20  648
     *,.3[illegible]E+0,.3197E+0,.5230E+0,.1642E+1,.2374E+1,.3807E+1,.5573E+1,  DAH20  649
     *,.3[illegible]E+0,.2918E+0,.5156E+0,.1079E+1,.2380E+1,.3954E+1,.6712E+1,  DAH20  650
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     *,.3370E+0,.5538E+0,.8423E+0,.1489E+1,.2580E+1,.4115E+1,.5910E+1,  DAH20  652
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     *,.35[illegible]E+0,.3721E+0,.6659E+0,.1310E+1,.2363E+1,.3270E+1,.3702E+1,  DAH20  655
     *,.3752E+0,.2656E+0,.4705E+0,.9901E+0,.2005E+1,.3627E+1,.5446E+1,  DAH20  656
     *,.3[illegible]E+0,.5300E+0,.7215E+0,.1238E+1,.2421E+1,.7574E+1,.1887E+2,  DAH20  657
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     *,.[illegible]E+0,.1382E+1,.1176E+1,.1332E+1,.1976E+1,.3187E+1,.5570E+1,  DAH20  659
     *,.[illegible]E+0,.4623E+0,.6952E+0,.1377E+1,.2550E+1,.5963E+1,.1334E+2,  DAH20  660
     *,.5[illegible]E+0,.2705E+0,.5461E+0,.1288E+1,.2627E+1,.4409E+1,.5741E+1/  DAH20  661
      DATA COEF33/                                                      DAH20  662
     *,.5133E+0,.5574E+0,.[illegible]E+0,.1399E+1,.2269E+1,.4027E+1,.5319E+1,  DAH20  663
     *,.5[illegible]E+0,.5803E+0,.7824E+0,.1288E+1,.2034E+1,.3568E+1,.4897E+1,  DAH20  664
     *,.5853E+0,.4311E+0,.6984E+0,.1288E+1,.2111E+1,.3319E+1,.3753E+1,  DAH20  665
     *,.6285E+0,.3016E+0,.5566E+0,.1145E+1,.2111E+1,.3470E+1,.3926E+1,  DAH20  666
     *,.5743E+0,.3131E+0,.5871E+0,.1228E+1,.2363E+1,.3866E+1,.4559E+1,  DAH20  667
     *,.7241E+0,.2902E+0,.5934E+0,.1303E+1,.2644E+1,.3729E+1,.4190E+1,  DAH20  668
     *,.7779E+0,.2773E+0,.5797E+0,.1332E+1,.2836E+1,.3930E+1,.4897E+1,  DAH20  669
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     *,.1415E+1,.2033E+0,.6669E+0,.3134E+1,.1419E+2,.2757E+2,.5066E+2,  DAH20  679
     *,.1469E+1,.2052E+0,.7593E+0,.3454E+1,.1565E+2,.3148E+2,.5526E+2,  DAH20  680
     *,.1516E+1,.2229E+0,.8643E+0,.3878E+1,.1730E+2,.3502E+2,.6712E+2/  DAH20  681
      DATA COEF34/                                                      DAH20  682
     *,.1556E+1,.2590E+0,.9830E+0,.4318E+1,.1911E+2,.4120E+2,.7683E+2,  DAH20  683
     *,.1587E+1,.3032E+0,.1113E+1,.4801E+1,.2111E+2,.4712E+2,.882[illegible]E+2,  DAH20  684
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 DATA COEF35/                                                      DAH20   702
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 DATA COEF36/                                                      DAH20   722
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*.3443E+0,.5590E+0,.5356E+0,.1124E+1,.3916E+1,.2141E+2,.3023E+3,   DAH20   727
*.3532E+0,.1103E+1,.7372E+0,.1340E+1,.5165E+1,.5376E+2,.1406E+4,   DAH20   728
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*.3776E+0,.9705E+0,.5976E+0,.9528E+0,.3043E+1,.9824E+1,.3069E+3,   DAH20   730
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*.4595E+0,.1705E+0,.3256E+0,.9082E+0,.2638E+1,.7574E+1,.2575E+2,   DAH20   734
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*.6367E+0,.1059E+0,.3623E+0,.1608E+1,.7739E+1,.2424E+2,.6670E+2,   DAH20   739
*.6835E+0,.1133E+0,.3959E+0,.1787E+1,.9088E+1,.2854E+2,.8190E+2,   DAH20   740
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 DATA COEF37/                                                      DAH20   742
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*,.8460E+0,.1393E+0,.5177E+0,.2427E+1,.1483E+2,.4682E+2,.1511E+3,      DAH20   744
*,.9071E+0,.1495E+0,.5661E+0,.2695E+1,.1747E+2,.5474E+2,.1858E+3,      DAH20   745
*,.9706E+0,.1600E+0,.6186E+0,.2985E+1,.2058E+2,.6501E+2,.2275E+3,      DAH20   746
*,.1037E+1,.1735E+0,.6763E+0,.3313E+1,.2421E+2,.7625E+2,.2791E+3,      DAH20   747
*,.1109E+1,.1836E+0,.7393E+0,.3670E+1,.2855E+2,.8993E+2,.3424E+3,      DAH20   748
*,.1172E+1,.1951E+0,.8087E+0,.4072E+1,.3359E+2,.1066E+3,.4196E+3,      DAH20   749
*,.1239E+1,.2098E+0,.8832E+0,.4511E+1,.3957E+2,.1256E+3,.5108E+3,      DAH20   750
*,.1304E+1,.2246E+0,.9651E+0,.5002E+1,.4655E+2,.1476E+3,.6290E+3,      DAH20   751
*,.1367E+1,.2410E+0,.1050E+1,.5546E+1,.5488E+2,.1745E+3,.7726E+3,      DAH20   752
*,.1425E+1,.2574E+0,.1145E+1,.6149E+1,.6449E+2,.2053E+3,.9456E+3,      DAH20   753
*,.1473E+1,.2497E+0,.1103E+1,.5829E+1,.6097E+2,.1945E+3,.8997E+3,      DAH20   754
*,.1526E+1,.2393E+0,.1050E+1,.5531E+1,.5793E+2,.1836E+3,.8486E+3,      DAH20   755
*,.1562E+1,.2311E+0,.1011E+1,.5241E+1,.5488E+2,.1740E+3,.8063E+3,      DAH20   756
*,.1592E+1,.2229E+0,.9683E+0,.4973E+1,.5200E+2,.1642E+3,.7641E+3,      DAH20   757
*,.1612E+1,.2184E+0,.9263E+0,.4720E+1,.4925E+2,.1554E+3,.7219E+3,      DAH20   758
*,.1622E+1,.2082E+0,.8864E+0,.4474E+1,.4661E+2,.1471E+3,.6839E+3,      DAH20   759
*,.1624E+1,.2016E+0,.8495E+0,.4243E+1,.4415E+2,.1399E+3,.6501E+3,      DAH20   760
*,.1610E+1,.1951E+0,.8129E+0,.4027E+1,.4180E+2,.1315E+3,.6164E+3/      DAH20   761
 DATA COEF38/                                                          DAH20   762
*,.1583E+1,.1859E+0,.7771E+0,.3819E+1,.3963E+2,.1241E+3,.5826E+3,      DAH20   763
*,.1559E+1,.1803E+0,.7435E+0,.3625E+1,.3752E+2,.1173E+3,.5530E+3,      DAH20   764
*,.1520E+1,.1754E+0,.7120E+0,.3439E+1,.3553E+2,.1109E+3,.5235E+3,      DAH20   765
*,.1473E+1,.1609E+0,.6805E+0,.3260E+1,.3365E+2,.1051E+3,.4939E+3,      DAH20   766
*,.1419E+1,.1634E+0,.6522E+0,.3089E+1,.3169E+2,.9922E+2,.4686E+3,      DAH20   767
*,.1360E+1,.1579E+0,.6239E+0,.2933E+1,.3019E+2,.9384E+2,.4433E+3,      DAH20   768
*,.1297E+1,.1523E+0,.5965E+0,.2784E+1,.2861E+2,.8895E+2,.4222E+3,      DAH20   769
*,.1232E+1,.1472E+0,.5713E+0,.2635E+1,.2709E+2,.8407E+2,.4006E+3,      DAH20   770
*,.1164E+1,.1421E+0,.5461E+0,.2501E+1,.2568E+2,.7967E+2,.3799E+3,      DAH20   771
*,.1097E+1,.1370E+0,.5230E+0,.2375E+1,.2427E+2,.7527E+2,.3597E+3,      DAH20   772
*,.1030E+1,.1325E+0,.5009E+0,.2248E+1,.2304E+2,.70[illegible]E+2,.3411E+3,      DAH20   773
*,.9539E+0,.1279E+0,.4799E+0,.2136E+1,.2181E+2,.6[illegible]E+2,.3210E+3,      DAH20   774
*,.9004E+0,.1233E+0,.4579E+0,.2025E+1,.2064E+2,.6354E+2,.3061E+3,      DAH20   775
*,.8395E+0,.1190E+0,.4390E+0,.1921E+1,.1952E+2,.6012E+2,.2900E+3,      DAH20   776
*,.7821E+0,.1151E+0,.4201E+0,.1824E+1,.1853E+2,.5570E+2,.2748E+3,      DAH20   777
*,.7284E+0,.1119E+0,.4012E+0,.1727E+1,.1753E+2,.5376E+2,.2605E+3,      DAH20   778
*,.6753E+0,.1072E+0,.3844E+0,.1638E+1,.1659E+2,.5063E+2,.2465E+3,      DAH20   779
*,.6318E+0,.1034E+0,.3676E+0,.1556E+1,.1577E+2,.4819E+2,.2335E+3,      DAH20   780
*,.5894E+0,.9984E-1,.3518E+0,.1476E+1,.1489E+2,.4560E+2,.2212E+3/      DAH20   781
 DATA COEF39/                                                          DAH20   782
*,.5509E+0,.9639E-1,.3371E+0,.1399E+1,.1413E+2,.4311E+2,.2098E+3,      DAH20   783
*,.5163E+0,.9311E-1,.3224E+0,.1325E+1,.1337E+2,.4076E+2,.1988E+3,      DAH20   784
*,.4846E+0,.8984E-1,.3088E+0,.1258E+1,.1266E+2,.3856E+2,.1883E+3,      DAH20   785
*,.4568E+0,.6918E-1,.2909E+0,.1466E+1,.1026E+2,.3211E+2,.9288E+2,      DAH20   786
*,.4323E+0,.7803E-1,.2299E+0,.1265E+1,.7622E+1,.2598E+2,.7599E+2,      DAH20   787
*,.4106E+0,.8820E-1,.3004E+0,.1332E+1,.5922E+1,.2143E+2,.6037E+2,      DAH20   788
*,.3920E+0,.1215E+0,.3382E+0,.1392E+1,.4079E+1,.1926E+2,.5485E+2,      DAH20   789
*,.3761E+0,.1689E+0,.4148E+0,.1571E+1,.4890E+1,.1862E+2,.5826E+2,      DAH20   790
*,.3630E+0,.1241E+0,.3550E+0,.1491E+1,.5183E+1,.1813E+2,.5488E+2,      DAH20   791
*,.3520E+0,.7426E-1,.2573E+0,.1280E+1,.5406E+1,.2121E+2,.6923E+2,      DAH20   792
*,.3437E+0,.1098E+0,.3413E+0,.1548E+1,.5593E+1,.2107E+2,.6332E+2,      DAH20   793
*,.3376E+0,.6525E-1,.2562E+0,.1414E+1,.6156E+1,.2185E+2,.6375E+2,      DAH20   794
*,.3335E+0,.6588E-1,.2562E+0,.1362E+1,.6332E+1,.2327E+2,.7303E+2,      DAH20   795
*,.3314E+0,.1041E+0,.3266E+0,.1504E+1,.6156E+1,.2460E+2,.8443E+2,      DAH20   796
*,.3321E+0,.1138E+0,.3109E+0,.1213E+1,.5292E+1,.1603E+2,.5319E+2,      DAH20   797
*,.3349E+0,.7164E-1,.2352E+0,.1146E+1,.4368E+1,.1554E+2,.4770E+2,      DAH2    798
*,.3391E+0,.4229E-1,.1680E+0,.9826E+0,.4133E+1,.1589E+2,.4665E+2,      DAH2    799
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     *.3459E+0,.4229E-1,.1701E+0,.9826E+0,.4374E+1,.1579E+2,.4686E+2,  DAH20   800
     *.3550E+0,.3410E-1,.1502E+0,.9454E+0,.4896E+1,.1862E+2,.5910E+2/  DAH20   801
      DATA COEF40/                                                     DAH20   802
     *.3656E+0,.3000E-1,.1365E+0,.8710E+0,.4620E+1,.1672E+2,.5150E+2,  DAH20   803
     *.3837E+0,.2525E-1,.1124E+0,.7518E+0,.4409E+1,.2121E+2,.8612E+2,  DAH20   804
     *.3972E+0,.5148E-1,.1596E+0,.9156E+0,.4954E+1,.2248E+2,.9203E+2,  DAH20   805
     *.4167E+0,.5246E-1,.1981E+0,.1635E+1,.5324E+1,.2454E+2,.9963E+2,  DAH20   806
     *.4393E+0,.4492E-1,.1838E+0,.1650E+1,.4679E+1,.1503E+2,.4475E+2,  DAH20   807
     *.4647E+0,.3770E-1,.1586E+0,.9603E+0,.4239E+1,.1632E+2,.5066E+2,  DAH20   808
     *.4934E+0,.5148E-1,.2027E+0,.1087E+1,.3471E+1,.9238E+1,.1777E+2,  DAH20   809
     *.5259E+0,.9229E-1,.2783E+0,.1176E+1,.3131E+1,.7820E+1,.1503E+2,  DAH20   810
     *.5619E+0,.9295E-1,.3004E+0,.1399E+1,.4655E+1,.1476E+2,.3681E+2,  DAH20   811
     *.6015E+0,.1164E+0,.3854E+0,.1742E+1,.8853E+1,.3729E+2,.1435E+3,  DAH20   812
     *.6453E+0,.1318E+0,.5146E+0,.2754E+1,.1455E+2,.6598E+2,.2584E+3,  DAH20   813
     *.6926E+0,.1490E+0,.6863E+0,.4355E+1,.2460E+2,.1178E+3,.4644E+3,  DAH20   814
     *.7436E+0,.1672E+0,.9158E+0,.6878E+1,.4151E+2,.2092E+3,.8317E+3,  DAH20   815
     *.7985E+0,.1902E+0,.1218E+1,.1079E+2,.6918E+2,.3729E+3,.1499E+4,  DAH20   816
     *.8573E+0,.1026E+1,.1730E+1,.3484E+1,.6496E+1,.1067E+2,.1513E+2,  DAH20   817
     *.9197E+0,.1100E+1,.1854E+1,.3734E+1,.6959E+1,.1144E+2,.1621E+2,  DAH20   818
     *.9829E+0,.1177E+1,.1983E+1,.3994E+1,.7446E+1,.1223E+2,.1735E+2,  DAH20   819
     *.1049E+1,.1256E+1,.2116E+1,.4264E+1,.7950E+1,.1306E+2,.1851E+2,  DAH20   820
     *.1116E+1,.1336E+1,.2251E+1,.4538E+1,.8460E+1,.1390E+2,.1970E+2/  DAH20   821
      DATA COEF41/                                                     DAH20   822
     *.1184E+1,.1418E+1,.2389E+1,.4813E+1,.8970E+1,.1474E+2,.2090E+2,  DAH20   823
     *.1251E+1,.1498E+1,.2525E+1,.5085E+1,.9480E+1,.1557E+2,.2208E+2,  DAH20   824
     *.1316E+1,.1575E+1,.2655E+1,.5349E+1,.9973E+1,.1638E+2,.2323E+2,  DAH20   825
     *.1379E+1,.1649E+1,.2780E+1,.5601E+1,.1044E+2,.1715E+2,.2432E+2,  DAH20   826
     *.1435E+1,.1718E+1,.2896E+1,.5834E+1,.1088E+2,.1787E+2,.2533E+2,  DAH20   827
     *.1487E+1,.1780E+1,.3000E+1,.6045E+1,.1127E+2,.1851E+2,.2624E+2,  DAH20   828
     *.1532E+1,.1834E+1,.3091E+1,.6228E+1,.1161E+2,.1907E+2,.2704E+2,  DAH20   829
     *.1569E+1,.1877E+1,.3165E+1,.6376E+1,.1188E+2,.1953E+2,.2769E+2,  DAH20   830
     *.1597E+1,.1911E+1,.3221E+1,.6489E+1,.1210E+2,.1987E+2,.2818E+2,  DAH20   831
     *.1615E+1,.1933E+1,.3259E+1,.6562E+1,.1223E+2,.2010E+2,.2849E+2,  DAH20   832
     *.1623E+1,.1943E+1,.3273E+1,.6595E+1,.1229E+2,.2020E+2,.2863E+2,  DAH20   833
     *.1620E+1,.1939E+1,.3268E+1,.6584E+1,.1227E+2,.2017E+2,.2859E+2,  DAH20   834
     *.1607E+1,.1925E+1,.3243E+1,.6532E+1,.1218E+2,.2001E+2,.2836E+2,  DAH20   835
     *.1584E+1,.1897E+1,.3197E+1,.6439E+1,.1200E+2,.1972E+2,.2796E+2,  DAH20   836
     *.1552E+1,.1857E+1,.3132E+1,.6308E+1,.1176E+2,.1932E+2,.2739E+2,  DAH20   837
     *.1511E+1,.1810E+1,.3049E+1,.6143E+1,.1145E+2,.1881E+2,.2667E+2,  DAH20   838
     *.1463E+1,.1751E+1,.2952E+1,.5946E+1,.1109E+2,.1821E+2,.2582E+2,  DAH20   839
     *.1409E+1,.1685E+1,.2842E+1,.5724E+1,.1067E+2,.1753E+2,.2485E+2,  DAH20   840
     *.1349E+1,.1614E+1,.2721E+1,.5482E+1,.1022E+2,.1679E+2,.2380E+2/  DAH20   841
      DATA COEF42/                                                     DAH20   842
     *.1285E+1,.1538E+1,.2593E+1,.5223E+1,.9738E+1,.1600E+2,.2268E+2,  DAH20   843
     *.1219E+1,.1459E+1,.2460E+1,.4955E+1,.9234E+1,.1518E+2,.2151E+2,  DAH20   844
     *.1152E+1,.1379E+1,.2323E+1,.4681E+1,.8724E+1,.1434E+2,.2032E+2,  DAH20   845
     *.1084E+1,.1298E+1,.2187E+1,.4405E+1,.8214E+1,.1349E+2,.1913E+2,  DAH20   846
     *.1017E+1,.1217E+1,.2052E+1,.4134E+1,.7704E+1,.1266E+2,.1795E+2,  DAH20   847
     *.9517E+0,.1139E+1,.1920E+1,.3868E+1,.7211E+1,.1185E+2,.1679E+2,  DAH20   848
     *.8893E+0,.1064E+1,.1793E+1,.3612E+1,.6731E+1,.1106E+2,.1568E+2,  DAH20   849
     *.8286E+0,.9920E+0,.1672E+1,.3368E+1,.6279E+1,.1031E+2,.1462E+2,  DAH20   850
     *.7718E+0,.9239E+0,.1557E+1,.3137E+1,.5847E+1,.9509E+1,.1362E+2,  DAH20   851
     *.7186E+0,.8632E+0,.1450E+1,.2920E+1,.5444E+1,.8944E+1,.1268E+2,  DAH20   852
     *.6691E+0,.8010E+0,.1351E+1,.2720E+1,.5070E+1,.8329E+1,.1181E+2,  DAH20   853
     *.6236E+0,.7466E+0,.1258E+1,.2535E+1,.4724E+1,.7762E+1,.1101E+2,  DAH20   854
     *.5820E+0,.6966E+0,.1174E+1,.2365E+1,.4408E+1,.7243E+1,.1027E+2,  DAH20   855
     *.5441E+0,.6511E+0,.1097E+1,.2211E+1,.4122E+1,.6769E+1,.9600E+1,  DAH20   856
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     *.5099E+0,.6103E+0,.1029E+1,.2072E+1,.3862E+1,.6344E+1,.8996E+1,   DAH20   857
     *.4791E+0,.5738E+0,.9668E+0,.1947E+1,.3638E+1,.5963E+1,.8456E+1,   DAH20   858
     *.4519E+0,.5410E+0,.9119E+0,.1837E+1,.3424E+1,.5626E+1,.7975E+1,   DAH20   859
     *.4280E+0,.5123E+0,.8634E+0,.1739E+1,.3242E+1,.5328E+1,.7553E+1,   DAH20   860
     *.4072E+0,.4872E+0,.8210E+0,.1654E+1,.3083E+1,.5064E+1,.7181E+1/   DAH20   861
      DATA COEF43/                                                       DAH20   862
     *.3089E+0,.4656E+0,.7846E+0,.1580E+1,.2946E+1,.4841E+1,.6864E+1,   DAH20   863
     *.3737E+0,.4470E+0,.7535E+0,.1518E+1,.2829E+1,.4649E+1,.6590E+1,   DAH20   864
     *.3608E+0,.4318E+0,.7277E+0,.1466E+1,.2733E+1,.4490E+1,.6366E+1,   DAH20   865
     *.3504E+0,.4193E+0,.7069E+0,.1424E+1,.2654E+1,.4361E+1,.6180E+1,   DAH20   866
     *.3422E+0,.4098E+0,.6907E+0,.1391E+1,.2593E+1,.4261E+1,.6041E+1,   DAH20   867
     *.3367E+0,.4029E+0,.6791E+0,.1368E+1,.2550E+1,.4189E+1,.5940E+1,   DAH20   868
     *.3331E+0,.3985E+0,.6718E+0,.1353E+1,.2523E+1,.4145E+1,.5877E+1,   DAH20   869
     *.3315E+0,.3969E+0,.6690E+0,.1347E+1,.2512E+1,.4127E+1,.5851E+1,   DAH20   870
     *.3324E+0,.3977E+0,.6704E+0,.1350E+1,.2518E+1,.4136E+1,.5864E+1,   DAH20   871
     *.3352E+0,.4011E+0,.6761E+0,.1362E+1,.2539E+1,.4172E+1,.5915E+1,   DAH20   872
     *.3400E+0,.4072E+0,.6853E+0,.1382E+1,.2577E+1,.4234E+1,.6003E+1,   DAH20   873
     *.3474E+0,.4159E+0,.7009E+0,.1412E+1,.2632E+1,.4325E+1,.6130E+1,   DAH20   874
     *.3569E+0,.4274E+0,.7202E+0,.1451E+1,.2705E+1,.4444E+1,.6299E+1,   DAH20   875
     *.3691E+0,.4415E+0,.7444E+0,.1499E+1,.2795E+1,.4593E+1,.6510E+1,   DAH20   876
     *.3834E+0,.4590E+0,.7737E+0,.1559E+1,.2905E+1,.4773E+1,.6767E+1,   DAH20   877
     *.4005E+0,.4795E+0,.8083E+0,.1628E+1,.3035E+1,.4985E+1,.7071E+1,   DAH20   878
     *.4207E+0,.5034E+0,.8487E+0,.1710E+1,.3186E+1,.5235E+1,.7422E+1,   DAH20   879
     *.4436E+0,.5310E+0,.8951E+0,.1803E+1,.3361E+1,.5523E+1,.7827E+1,   DAH20   880
     *.4699E+0,.5623E+0,.9478E+0,.1909E+1,.3559E+1,.5846E+1,.8291E+1/   DAH20   881
      DATA COEF44/                                                       DAH20   882
     *.4992E+0,.5977E+0,.1007E+1,.2029E+1,.3782E+1,.6217E+1,.8811E+1,   DAH20   883
     *.5322E+0,.6372E+0,.1074E+1,.2163E+1,.4033E+1,.6628E+1,.9393E+1,   DAH20   884
     *.5689E+0,.6810E+0,.1148E+1,.2312E+1,.4310E+1,.7082E+1,.1004E+2,   DAH20   885
     *.6093E+0,.7293E+0,.1230E+1,.2477E+1,.4616E+1,.7586E+1,.1075E+2,   DAH20   886
     *.6539E+0,.7825E+0,.1319E+1,.2657E+1,.4952E+1,.8138E+1,.1153E+2,   DAH20   887
     *.7014E+0,.8400E+0,.1416E+1,.2853E+1,.5316E+1,.8734E+1,.1238E+2,   DAH20   888
     *.7537E+0,.9023E+0,.1521E+1,.3063E+1,.5710E+1,.9384E+1,.1330E+2,   DAH20   889
     *.8093E+0,.9688E+0,.1633E+1,.3290E+1,.6133E+1,.1007E+2,.1428E+2,   DAH20   890
     *.8686E+0,.1040E+1,.1752E+1,.3529E+1,.6578E+1,.1081E+2,.1532E+2,   DAH20   891
     *.9306E+0,.1114E+1,.1876E+1,.3782E+1,.7047E+1,.1158E+2,.1642E+2,   DAH20   892
     *.9951E+0,.1191E+1,.2009E+1,.4044E+1,.7540E+1,.1239E+2,.1756E+2,   DAH20   893
     *.1062E+1,.1271E+1,.2141E+1,.4315E+1,.8044E+1,.1322E+2,.1874E+2,   DAH20   894
     *.1129E+1,.1352E+1,.2279E+1,.4589E+1,.8554E+1,.1406E+2,.1993E+2,   DAH20   895
     *.1197E+1,.1433E+1,.2414E+1,.4864E+1,.9064E+1,.1490E+2,.2112E+2,   DAH20   896
     *.1263E+1,.1512E+1,.2549E+1,.5135E+1,.9574E+1,.1573E+2,.2229E+2,   DAH20   897
     *.1328E+1,.1590E+1,.2679E+1,.5398E+1,.1006E+2,.1653E+2,.2343E+2,   DAH20   898
     *.1389E+1,.1662E+1,.2803E+1,.5646E+1,.1052E+2,.1729E+2,.2452E+2,   DAH20   899
     *.1446E+1,.1731E+1,.2916E+1,.5875E+1,.1095E+2,.1800E+2,.2551E+2,   DAH20   900
     *.1496E+1,.1790E+1,.3018E+1,.6080E+1,.1133E+2,.1862E+2,.2640E+2/   DAH20   901
      DATA COEF45/                                                       DAH20   902
     *.1541E+1,.1843E+1,.3106E+1,.6257E+1,.1166E+2,.1916E+2,.2717E+2,   DAH20   903
     *.1575E+1,.1885E+1,.3177E+1,.6400E+1,.1193E+2,.1960E+2,.2779E+2,   DAH20   904
     *.1601E+1,.1916E+1,.3229E+1,.6505E+1,.1212E+2,.1993E+2,.2825E+2,   DAH20   905
     *.1617E+1,.1936E+1,.3262E+1,.6572E+1,.1225E+2,.2013E+2,.2853E+2,   DAH20   906
     *.1623E+1,.1943E+1,.3275E+1,.6595E+1,.1229E+2,.2020E+2,.2864E+2,   DAH20   907
     *.1619E+1,.1938E+1,.3265E+1,.6578E+1,.1226E+2,.2015E+2,.2856E+2,   DAH20   908
     *.1604E+1,.1920E+1,.3236E+1,.6518E+1,.1215E+2,.1996E+2,.2830E+2,   DAH20   909
     *.1579E+1,.1890E+1,.3185E+1,.6417E+1,.1196E+2,.1965E+2,.2786E+2,   DAH20   910
     *.1545E+1,.1849E+1,.3117E+1,.6280E+1,.1171E+2,.1923E+2,.2727E+2,   DAH20   911
     *.1503E+1,.1798E+1,.3032E+1,.6109E+1,.1139E+2,.1870E+2,.2652E+2,   DAH20   912
     *.1453E+1,.1739E+1,.2932E+1,.5907E+1,.1101E+2,.1809E+2,.2565E+2,   DAH20   913
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     *.1338E+1,.1674E+1,.2820E+1,.5681E+1,.1059E+2,.1740E+2,.2466E+2,  DAH20   914
     *.1337E+1,.1600E+1,.2698E+1,.5434E+1,.1013E+2,.1664E+2,.2359E+2,  DAH20   915
     *.1273E+1,.1524E+1,.2569E+1,.5174E+1,.9645E+1,.1585E+2,.2246E+2,  DAH20   916
     *.1207E+1,.1444E+1,.2434E+1,.4904E+1,.9140E+1,.1502E+2,.2129E+2,  DAH20   917
     *.1139E+1,.1363E+1,.2298E+1,.4629E+1,.8630E+1,.1418E+2,.2010E+2,  DAH20   918
     *.1071E+1,.1282E+1,.2161E+1,.4354E+1,.8114E+1,.1334E+2,.1890E+2,  DAH20   919
     *.1005E+1,.1203E+1,.2027E+1,.4083E+1,.7610E+1,.1251E+2,.1773E+2,  DAH20   920
     *.9398E+0,.1125E+1,.1896E+1,.3820E+1,.7118E+1,.1170E+2,.1658E+2/  DAH20   921
      DATA COEF46/                                                     DAH20   922
     *.8772E+0,.1050E+1,.1770E+1,.3566E+1,.6649E+1,.1092E+2,.1548E+2,  DAH20   923
     *.8179E+0,.9768E+0,.1650E+1,.3324E+1,.6197E+1,.1018E+2,.1443E+2,  DAH20   924
     *.7617E+0,.9116E+0,.1536E+1,.3095E+1,.5770E+1,.9482E+1,.1344E+2,  DAH20   925
     *.7091E+0,.8489E+0,.1430E+1,.2882E+1,.5372E+1,.8827E+1,.1251E+2,  DAH20   926
     *.6605E+0,.7905E+0,.1333E+1,.2684E+1,.5003E+1,.8221E+1,.1165E+2,  DAH20   927
     *.6156E+0,.7369E+0,.1242E+1,.2502E+1,.4663E+1,.7664E+1,.1086E+2,  DAH20   928
     *.5747E+0,.6877E+0,.1159E+1,.2335E+1,.4353E+1,.7151E+1,.1014E+2,  DAH20   929
     *.5374E+0,.6433E+0,.1084E+1,.2184E+1,.4071E+1,.6591E+1,.9482E+1,  DAH20   930
     *.5034E+0,.6031E+0,.1016E+1,.2046E+1,.3817E+1,.6271E+1,.8891E+1,  DAH20   931
     *.4739E+0,.5672E+0,.9560E+0,.1926E+1,.3590E+1,.5899E+1,.8363E+1,  DAH20   932
     *.4473E+0,.5354E+0,.9023E+0,.1818E+1,.3388E+1,.5567E+1,.7893E+1,  DAH20   933
     *.4235E+0,.5072E+0,.8551E+0,.1723E+1,.3211E+1,.5274E+1,.7477E+1,  DAH20   934
     *.4033E+0,.4828E+0,.8138E+0,.1639E+1,.3056E+1,.5020E+1,.7118E+1,  DAH20   935
     *.3859E+0,.4618E+0,.7784E+0,.1568E+1,.2923E+1,.4802E+1,.6810E+1,  DAH20   936
     *.3709E+0,.4439E+0,.7484E+0,.1507E+1,.2810E+1,.4617E+1,.6544E+1,  DAH20   937
     *.3587E+0,.4292E+0,.7235E+0,.1458E+1,.2718E+1,.4463E+1,.6328E+1,  DAH20   938
     *.3486E+0,.4174E+0,.7034E+0,.1417E+1,.2641E+1,.4340E+1,.6151E+1,  DAH20   939
     *.3413E+0,.4084E+0,.6882E+0,.1386E+1,.2584E+1,.4246E+1,.6020E+1,  DAH20   940
     *.3359E+0,.4018E+0,.6774E+0,.1364E+1,.2543E+1,.4179E+1,.5923E+1/  DAH20   941
      DATA COEF47/                                                     DAH20   942
     *.3327E+0,.3980E+0,.6710E+0,.1352E+1,.2519E+1,.4140E+1,.5868E+1,  DAH20   943
     *.3315E+0,.3969E+0,.6689E+0,.1347E+1,.2512E+1,.4127E+1,.5851E+1,  DAH20   944
     *.3327E+0,.3982E+0,.6712E+0,.1352E+1,.2520E+1,.4141E+1,.5872E+1,  DAH20   945
     *.3359E+0,.4025E+0,.6777E+0,.1365E+1,.2545E+1,.4181E+1,.5927E+1,  DAH20   946
     *.3413E+0,.4087E+0,.6887E+0,.1388E+1,.2586E+1,.4249E+1,.6024E+1,  DAH20   947
     *.3489E+0,.4179E+0,.7042E+0,.1419E+1,.2644E+1,.4345E+1,.6159E+1,  DAH20   948
     *.3590E+0,.4298E+0,.7244E+0,.1459E+1,.2720E+1,.4469E+1,.6337E+1,  DAH20   949
     *.3715E+0,.4448E+0,.7495E+0,.1510E+1,.2814E+1,.4624E+1,.6556E+1,  DAH20   950
     *.3865E+0,.4626E+0,.7798E+0,.1571E+1,.2928E+1,.4811E+1,.6818E+1,  DAH20   951
     *.4042E+0,.4838E+0,.8154E+0,.1643E+1,.3062E+1,.5029E+1,.7130E+1,  DAH20   952
     *.4247E+0,.5084E+0,.8569E+0,.1726E+1,.3218E+1,.5288E+1,.7493E+1,  DAH20   953
     *.4482E+0,.5366E+0,.9044E+0,.1822E+1,.3396E+1,.5582E+1,.7911E+1,  DAH20   954
     *.4751E+0,.5687E+0,.9584E+0,.1931E+1,.3599E+1,.5914E+1,.8384E+1,  DAH20   955
     *.5050E+0,.6048E+0,.1019E+1,.2053E+1,.3827E+1,.6290E+1,.8916E+1,  DAH20   956
     *.5389E+0,.6449E+0,.1087E+1,.2190E+1,.4082E+1,.6706E+1,.9507E+1,  DAH20   957
     *.5762E+0,.6897E+0,.1163E+1,.2342E+1,.4365E+1,.7170E+1,.1017E+2,  DAH20   958
     *.6175E+0,.7390E+0,.1246E+1,.2509E+1,.4677E+1,.7683E+1,.1089E+2,  DAH20   959
     *.6624E+0,.7928E+0,.1336E+1,.2692E+1,.5017E+1,.8245E+1,.1169E+2,  DAH20   960
     *.7113E+0,.8513E+0,.1435E+1,.2891E+1,.5388E+1,.8851E+1,.1255E+2/  DAH20   961
      DATA COEF48/                                                     DAH20   962
     *.7633E+0,.9144E+0,.1541E+1,.3105E+1,.5787E+1,.9506E+1,.1348E+2,  DAH20   963
     *.8203E+0,.9818E+0,.1655E+1,.3333E+1,.6215E+1,.[illegible]21E+2,.1447E+2/  DAH20   964
      END                                                              DAH20   965
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      SUBROUTINE SIGNIR
      COMMON /OUT/ EQAREA(20), TMAX(20), ANG(20), ITOT, IANHOT
      COMMON/EXIT/ RSN,RPN,RP,XP,ANL,RTE
C     PROGRAM SIGNIR
      DIMENSION X10(5),Y10(5),X20(5),Y20(5),VECTO(5),TEMPO(5),NODEO(5),
     1X1(55),Y1(55),X2(55),Y2(55),DUM53(5),        YOUCT(4),ROUCT(4),
     2 FE(30,50),TITLE(5,8),YF(10,20),RF(10,20),XU1(20),YU1(20),
     3XU2(20),YU2(20),          F(50,50),VECT(55)
      COMMON/PLH/QB(5000)
      COMMON /PRINT/ PRINT1, PRINT2, PRINT3, PRINT4, PRINT5,
     *                PRINT6, PRINT7, PRINT8, PRINT9, PRINT0
      COMMON/ALL/ N,NN,NNN,ISURF(50),NODE(55),JSURF(5,2),KF(5),NTOT1,
     *            NOP,NP(10), AREA(80)
      COMMON /THY/ TH(80),NTOT2
      COMMON /TAIL/ NF,YFA(30),YFB(30),RFA(30),RFB(30),TPL,EMH(80)
      EQUIVALENCE (QB(1),FE(1)),(QB(1501),F(1)),(QB(4001),X1(1)),
     1(QB(4056),Y1(1)),(QB(4111),X2(1)),(QB(4166),Y2(1)),(QB(4221),
     2VECT(1)),(QB(4276),DUM53(1)),(QB(4281),YF(1)),(QB(4481),RF(1))
      COMMON/AAA/ YOUCT,ROUCT,IOUCT
      COMMON/BB/NODEN3(30),TF1A(30),NNAT
      COMMON/CC/NODEN4(10),WT1(10),LUU,KOOLT
      INTEGER PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8
     1,PRINT9,PRINT0
      READ(5,1) IANHOT
      IF(IANHOT.EQ.0) RETURN
      IF(IANHOT.NE.2)  GO TO 2222
      READ(5,1) ITOT
      DO 2220 I=1,ITOT
 2220 READ(5,2) EQAREA(I), TMAX(I), ANG(I)
      RETURN
 2222 CONTINUE
      DO 311 I=1,5
  311 READ(5,309)  (TITLE(I,J),J=1,8)
  309 FORMAT(8A10)
      READ(5,1) PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8
     1,PRINT9,PRINT0
      READ(5,1) NN,NNN,N,NO,NNNN
      NOP=N+NNNN
    1 FORMAT(2X,20I2)
      READ(5,3)(X1(I),Y1(I),X2(I),Y2(I),VECT(I),NODE(I),ISURF(I),
     1I=1,NOP)
    3 FORMAT(5F10.5,2I2)
      READ(5,2) (X10(I),Y10(I),X20(I),Y20(I),VECTO(I),TEMPO(I),NODEO(I),
     1I=1,NO)
      IOUCT=0
         IF(IOUCT.EQ.0) GO TO 2000
      WRITE(2) IOUCT
      REWIND 2
      READ(2) IOUCT
      REWIND 2
 2000 READ(5,2) TPL
    2 FORMAT(6F10.5,I2)
      XP=0.0
      RP=0.0
      ANL=TPL
      IF(NINN.NE.0)  GO TO 150
      INJ=1
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      DO 110 I=2,NO                                                    SIGNIR  59
      IF(X1O(I).GT.X1O(INO)) INO=I                                     SIGNIR  60
  110 CONTINUE                                                         SIGNIR  61
      IMIN=1                                                           SIGNIR  62
      DO 120 I=2,N                                                     SIGNIR  63
      IF(Y2(I).LT.Y2(IMIN))  IMIN=I                                    SIGNIR  64
  120 CONTINUE                                                         SIGNIR  65
      JJ=0                                                             SIGNIR  66
      DO 130 I=1,N                                                     SIGNIR  67
      IF(ISURF(I).NE.ISURF(IMIN)) GO TO 130                            SIGNIR  68
      JJ=JJ+1                                                          SIGNIR  69
      XU2(JJ)=X2(I)                                                    SIGNIR  70
      YU2(JJ)=Y2(I)                                                    SIGNIR  71
  130 CONTINUE                                                         SIGNIR  72
      CALL ORDER (XU2,YU2,JJ)                                          SIGNIR  73
      IF(XU2(JJ).LE.X1O(INO))   GO TO 150                              SIGNIR  74
      XP=XU2(JJ)-X1O(INO)                                              SIGNIR  75
      ANL=X1O(INO)                                                     SIGNIR  76
      CALL TABLEL(XU2,YU2,X1O(INO),RP,DXDY,JJ)                         SIGNIR  77
  150 DO 101 I=1,NO                                                    SIGNIR  78
  101 TEMPO(I)=TEMPO(I)-460.0                                          SIGNIR  79
      NTOT1=N+NO                                                       SIGNIR  80
      READ(5,1) KKI,KKKI                                               SIGNIR  81
      CALL TITLA (TITLE,KKI)                                           SIGNIR  82
      IF(KKI .EQ. 0) GO TO 4                                           SIGNIR  83
      READ(5,1) NNAT                                                   SIGNIR  84
      NTOT2=NTOT1+NNAT                                                 SIGNIR  85
      IF(IDUCT .NE. 0) NTOT2=NTOT2+1                                   SIGNIR  86
      READ(5,1043)(TW(I),I=1,NTOT2)                                    SIGNIR  87
 1043 FORMAT(8F10.3)                                                   SIGNIR  88
    5 FORMAT(8F10.5)                                                   SIGNIR  89
 1013 FORMAT(1H1,28X,"SYSTEM NODE TEMPERATURES",//)                    SIGNIR  90
 1014 FORMAT(35X,"NODE NO. ",I2,/26X,"TEMPERATURE=",F7.2," DEG. R.",/) SIGNIR  91
      IF(PRINT7 .EQ. 0) GO TO 4                                        SIGNIR  92
      WRITE(6,1013)                                                    SIGNIR  93
      LINECT=4                                                         SIGNIR  94
      DO 201 I=1,NTOT2                                                 SIGNIR  95
      IF(LINECT .LE. 58) GO TO 203                                     SIGNIR  96
      WRITE(6,1013)                                                    SIGNIR  97
      LINECT=4                                                         SIGNIR  98
  203 WRITE(6,1014) I,TW(I)                                            SIGNIR  99
      LINECT=LINECT+3                                                  SIGNIR  100
  201 CONTINUE                                                         SIGNIR  101
    4 IF(KKKI.LE.0)  GO TO 9                                           SIGNIR  102
      IF(PRINT6 .EQ. 0) GO TO 60                                       SIGNIR  103
      WRITE(6,1010)                                                    SIGNIR  104
 1010 FORMAT(1H1,26X,28HSYSTEM INTERNAL VIEW FACTORS,//)               SIGNIR  105
      LINEV=4                                                          SIGNIR  106
   60 IF(IDUCT .NE. 0) NTOT1=NTOT1+1                                   SIGNIR  107
      DO 733 I=1,NTOT1                                                 SIGNIR  108
      READ(5,5)(F(I,J),J=I,NTOT1)                                      SIGNIR  109
  733 READ(5,5) AREA(I)                                                SIGNIR  110
      DO 57 I=1,NTOT1                                                  SIGNIR  111
      IF(PRINT6 .EQ. 0) GO TO 53                                       SIGNIR  112
      DO 58 J=I,NTOT1                                                  SIGNIR  113
      IF(LINEV .LT. 55) GO TO 55                                       SIGNIR  114
      WRITE(6,1010)                                                    SIGNIR  115
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```
      LINEV=6                                                           SIGNIR 116
   55 WRITE(6,1811) I,J,F(I,J)                                          SIGNIR 117
 1811 FORMAT(32X,"F(",I2,",",I2,")=",F7.5)                              SIGNIR 118
      LINEV=LINEV+1                                                     SIGNIR 119
   58 CONTINUE                                                          SIGNIR 120
      IF(PRINT6 .EQ. 0) GO TO 53                                        SIGNIR 121
      WRITE(6,1012) I,AREA(I)                                           SIGNIR 122
 1012 FORMAT(28X,"AREA(",I2,")=",F7.2," SQ. IN.",//)                    SIGNIR 123
      LINEV=LINEV+2                                                     SIGNIR 124
   53 IF(KKI .NE. 0) GO TO 57                                           SIGNIR 125
      AREA(I)=AREA(I)/144.0                                             SIGNIR 126
   57 CONTINUE                                                          SIGNIR 127
    9 IF(KKI .EQ. 0) GO TO 10                                           SIGNIR 128
      DO 6 I=1,NN                                                       SIGNIR 129
      READ(5,2) XF(I)                                                   SIGNIR 130
    6 READ(5,1)(JSURF(I,II),II=1,2)                                     SIGNIR 131
      GO TO 11                                                          SIGNIR 132
   10 CALL OVERLAY(4HMRHR,9,0)                                          SIGNIR 133
C10   CALL REMAIN3                                                      SIGNIR 134
      NTOT2=NTOT1+NNAT                                                  SIGNIR 135
      DO 36 I=1,80                                                      SIGNIR 136
   36 TW(I)=-530.                                                       SIGNIR 137
      DO 37 I=1,NNAT                                                    SIGNIR 138
      IJ=NODEN3(I)                                                      SIGNIR 139
   37 TW(IJ)=TRIA(I)                                                    SIGNIR 140
      DO 38 I =1,NO                                                     SIGNIR 141
      IJ=NODEO(I)                                                       SIGNIR 142
   38 TW(IJ)=TEMPO(I)                                                   SIGNIR 143
      IF(KOOLT .EQ. 0) GO TO 11                                         SIGNIR 144
      DO 39 I=1,LUI                                                     SIGNIR 145
      IJ=NODEN4(I)                                                      SIGNIR 146
   39 TW(IJ)=WT1(I)                                                     SIGNIR 147
   11 DO 40 I=1,NN                                                      SIGNIR 148
      CALL ARRAY(X1,Y1,X2,Y2,XF,N,I,ISURF,JSURF,XU1,YU1,XU2,YU2,KK,     SIGNIR 149
     1KKK,1)                                                            SIGNIR 150
      J=1                                                               SIGNIR 151
      ISUR=JSURF(I,J)                                                   SIGNIR 152
      NP(ISUR)=KK                                                       SIGNIR 153
      DO 46 JJ=1,KK                                                     SIGNIR 154
      YF(ISUR,JJ)= XU1(JJ)                                              SIGNIR 155
   46 RF(ISUR,JJ)=YU1(JJ)+0.015                                         SIGNIR 156
      J=2                                                               SIGNIR 157
      ISUR=JSURF(I,J)                                                   SIGNIR 158
      NP(ISUR)=KKK                                                      SIGNIR 159
      DO 47 JJ=1,KKK                                                    SIGNIR 160
      YF(ISUR,JJ)=XU2(JJ)                                               SIGNIR 161
   47 RF(ISUR,JJ)=YU2(JJ)-0.015                                         SIGNIR 162
      IF(RF(ISUR,KKK) .GE. 0.0) GO TO 48                                SIGNIR 163
      RF(ISUR,KKK)=0.0                                                  SIGNIR 164
      YF(ISUR,KKK)=YF(ISUR,KKK)-0.015                                   SIGNIR 165
   48 CONTINUE                                                          SIGNIR 166
      NOO=N+1                                                           SIGNIR 167
      IIJ=0                                                             SIGNIR 168
      DO 42 I=NOO,NTOT1                                                 SIGNIR 169
      IIJ=IIJ+1                                                         SIGNIR 170
      X1(I)=X10(IIJ)                                                    SIGNIR 171
      Y1(I)=Y10(IIJ)                                                    SIGNIR 172
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      X2(I)=X20(IIJ)                                          SIGNIR    173
      Y2(I)=Y20(IIJ)                                          SIGNIR    174
      VECT(I)=VECTO(IIJ)                                      SIGNIR    175
   42 NODE(I)=NODEO(IIJ)                                      SIGNIR    176
      IF(KKKI.LT.1)  GO TO 59                                 SIGNIR    177
      CALL OVERLAY(4HXRHP,10,0)                               SIGNIR    178
C     CALL VIEWS                                              SIGNIR    179
      IF(IDUCT .NE. 0) NTOT2=NTOT2+1                          SIGNIR    180
   59 IF(KKI .NE. 0) GO TO 56                                 SIGNIR    181
      READ(5,1) NCK                                           SIGNIR    182
      IF(NCK .EQ. 0) GO TO 400                                SIGNIR    183
      CALL COND(NCK,KKI)                                      SIGNIR    184
  400 NTOT3=NTOT1+1                                           SIGNIR    185
      DO 72 I=NTOT3,NTOT2                                     SIGNIR    186
      AREA(I)=1.0                                             SIGNIR    187
   72 EMM(I)=0.0                                              SIGNIR    188
   56 READ(5,5)(EMM(I),I=1,NTOT1)                             SIGNIR    189
      IF(KKI . E. 0) GO TO 70                                 SIGNIR    190
      CALL OVERLAY(4HXRHP,11,0)                               SIGNIR    191
C     CALL TASIBS                                             SIGNIR    192
   70 CALL OVERLAY(4HXRHP,12,0)                               SIGNIR    193
C70   CALL TAILS                                              SIGNIR    194
      RETURN                                                  SIGNIR    195
      END                                                     SIGNIR    196
```

```
      SUBROUTINE TABLEL(XT,YT,X,Y,DYDX,NT)                              TABLEL
      DIMENSION XT(1), YT(1)                                            TABLEL
      IF(NT-2) 300,200,100                                              TABLEL
  100 IF(NT.GT.3)  GO TO 150                                            TABLEL
      DEL=SIGN(0.001,XT(3)-XT(1))                                       TABLEL
      XT(4)=XT(3)+DEL                                                   TABLEL
      YT(4)=((YT(3)-YT(2))*(XT(4)-XT(2)))/(XT(3)-XT(2))+YT(2)           TABLEL
      I=3                                                               TABLEL
      IF(DEL) 4,30L,13                                                  TABLEL
  150 NT2=NT-1                                                          TABLEL
      IF (XT(1).LT.XT(NT))  GO TO 6                                     TABLEL
      DO 12 I=3,NT2                                                     TABLEL
         IF(X-XT(I)) 12,13,13                                           TABLEL
   12 CONTINUE                                                          TABLEL
      I=NT2                                                             TABLEL
   13 I=I-1                                                             TABLEL
      X0=XT(I+2)                                                        TABLEL
      Y0=YT(I+2)                                                        TABLEL
      X1=XT(I+1)                                                        TABLEL
      Y1=YT(I+1)                                                        TABLEL
      X2=XT(I)                                                          TABLEL
      Y2=YT(I)                                                          TABLEL
      X3=XT(I-1)                                                        TABLEL
      Y3=YT(I-1)                                                        TABLEL
      GO TO 15                                                          TABLEL
    6 DO 1 I=3,NT2                                                      TABLEL
         IF(X-XT(I)) 4,4,1                                              TABLEL
    1 CONTINUE                                                          TABLEL
      I=NT2                                                             TABLEL
    4 I=I-1                                                             TABLEL
      X0=XT(I-1)                                                        TABLEL
      Y0=YT(I-1)                                                        TABLEL
      X1=XT(I)                                                          TABLEL
      Y1=YT(I)                                                          TABLEL
      X2=XT(I+1)                                                        TABLEL
      Y2=YT(I+1)                                                        TABLEL
      X3=XT(I+2)                                                        TABLEL
      Y3=YT(I+2)                                                        TABLEL
   15 A = Y0/((X0-X1)*(X0-X2)*(X0-X3))                                  TABLEL
      B = Y1/((X1-X0)*(X1-X2)*(X1-X3))                                  TABLEL
      C = Y2/((X2-X0)*(X2-X1)*(X2-X3))                                  TABLEL
      D = Y3/((X3-X0)*(X3-X1)*(Y3-X2))                                  TABLEL
      Y = A*((X-X1)*(X-X2)*(X-X3))                                      TABLEL
     2   +B*((X-X0)*(X-X2)*(X-X3))                                      TABLEL
     3   +C*((X-X0)*(X-X1)*(X-X3))                                      TABLEL
     4   +D*((X-X0)*(X-X1)*(X-X2))                                      TABLEL
      DYDX=A*(3.*X*X-2.*X*(X1+X2+X3)+(X1*X2+X1*X3+X2*X3))               TABLEL
     2     +B*(3.*X*X-2.*X*(X0+X2+X3)+(X0*X2+X0*X3+X2*X3))              TABLEL
     3     +C*(3.*X*X-2.*X*(X0+X1+X3)+(X0*X1+X0*X3+X1*X3))              TABLEL
     4     +D*(3.*X*X-2.*X*(X0+X1+X2)+(X0*X1+X0*X2+X1*X2))              TABLEL
      RETURN                                                            TABLEL
  200 X1=X-XT(1)                                                        TABLEL
      X2=XT(2)-XT(1)                                                    TABLEL
      Y2=YT(2)-YT(1)                                                    TABLEL
      Y=YT(1)+(X1/X2)*Y2                                                TABLEL
      DYDX=Y2/X2                                                        TABLEL
      RETURN                                                            TABLEL
```

```
            300 WRITE(6,310)                                              TABLEL    59
      60    310 FORMAT('0INSUFFICIENT TABLE SIZE --- TABLEL')             TABLEL    60
                STOP                                                      TABLEL    61
                END                                                       TABLEL    62
```

```
      SUBROUTINE ARRAY(X1,Y1,X2,Y2,XF,N,I,ISURF,JSURF,XU1,YU1,XU2,YU2,
     1KK,KKK,KU1)
      DIMENSION X1(1),X2(1),Y1(1),Y2(1),ISURF(1),JSURF(5,2),XF(1)
      DIMENSION XX1(20),XX2(20),YY1(20),YY2(20),XU1(1),YU1(1),XU2(1),
     1YU2(1)
    1 DO 20 II=1,2
      KU1=0
      JJ=0
      DO 6 J=1,N
      IF(JSURF(I,II)-ISURF(J)) 6,5,6
    5 JJ=JJ+1
      XX1(JJ)=X1(J)
      XX2(JJ)=X2(J)
      YY1(JJ)=Y1(J)
      YY2(JJ)=Y2(J)
    6 CONTINUE
      IF(JJ.LT.2)  GO TO 3
      CALL ORDER(XX1,YY1,JJ)
      CALL ORDER(XX2,YY2,JJ)
    3 IF (II.GT.1)  GO TO 10
      DO 2 J=1,JJ
      IF(XX1(J).GT.XF(I)) KU1=1
      XU1(J)=XX1(J)
      YU1(J)=YY1(J)
      IF(KU1 .GT. 0) GO TO 14
    2 CONTINUE
      KK=JJ+1
      XU1(KK)=XX2(JJ)
      YU1(KK)=YY2(JJ)
      GO TO 20
   10 DO 13 J=1,JJ
      IF(KU1 .NE. 0) GO TO 25
      IF(XX1(J).GT.XF(I)) KU1=1
   25 XU2(J)=XX1(J)
      YU2(J)=YY1(J)
      IF(KU1 .GT. 0) GO TO 15
   13 CONTINUE
      KKK=JJ+1
      XU2(KKK)=XX2(JJ)
      YU2(KKK)=YY2(JJ)
      GO TO 20
   14 KK=J
      GO TO 20
   15 KKK=J
   20 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE ORDER(X,Y,NUM)
      DIMENSION X(1),Y(1)
      K=NUM-1
      DO 10 I=1,K
      M=NUM-I
      DO 10 J=1,M
      IF(X(J)-X(J+1)) 10,10,5
    5 TEMPX=X(J)
      TEMPY=Y(J)
      X(J)=X(J+1)
      Y(J)=Y(J+1)
      X(J+1)=TEMPX
      Y(J+1)=TEMPY
   10 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE COND(N,KKI)                                          COND   2
      COMMON /HTPACK/ IHT(80),HTARY(80),IHTS                          COND   3
       COMMON /TNX/CT(80),NTOT2                                       COND   4
      DO 10 I=1,N                                                     COND   5
      IHTS=IHTS+1                                                     COND   6
      READ(5,2) NODE1,NODE2,HTARY(IHTS)                               COND   7
   10 IHT(IHTS)=NODE1*100+NODE2                                       COND   8
    2 FORMAT(2X,2I2,4X,F10.5)                                         COND   9
      IF(KKI .GT. 0) GO TO 20                                         COND  10
      READ(5,2)  NN                                                   COND  11
      IF(NN .EQ. 0) GO TO 20                                          COND  12
      NTOT2=NN+NTOT2                                                  COND  13
      DO 15 I=1,NN                                                    COND  14
      READ(5,4) NODE1,T                                               COND  15
   15 CT(NODE1)=T-460.                                                COND  16
    4 FORMAT(2X,I2,5X,F10.5)                                          COND  17
   20 RETURN                                                          COND  18
      END                                                             COND  19
```

```
      SUBROUTINE TITLA (TITLE,KKI)                                      TITLA   2
      COMMON /PRINT/ PRINT1, PRINT2, PRINT3, PRINT4, PRINT5,            TITLA   3
     *               PRINT6, PRINT7, PRINT8, PRINT9, PRINTO             TITLA   4
      DIMENSION TITLE(5,8)                                              TITLA   5
      INTEGER PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8,  TITLA   6
     1PRINTO                                                            TITLA   7
      WRITE(6,1)                                                        TITLA   8
    1 FORMAT(1H1,//////////,8X,63(1H*),/8X,1H*,61X,1H*,/,8X,1H*,13X,"A I TITLA   9
     1R C R A F T   S I G N A T U R E",13X,1H*,/,8X,1H*,61X,            TITLA  10
     21H*,/,8X,1H*,13X,"P R E D I C T I O N   P R O G R A M",13X,1H*,/, TITLA  11
     38X,1H*,61X,1H*,/,8X,63(1H*),//////////,31X,"TITLE INFORMATION",/) TITLA  12
      DO 2 I=1,5                                                        TITLA  13
    2 WRITE(6,3) (TITLE(I,J),J=1,8)                                     TITLA  14
    3 FORMAT(10X,8A10)                                                  TITLA  15
      WRITE(6,4)                                                        TITLA  16
    4 FORMAT(//////////,16X,"THESE RESULTS CONTAIN THE FOLLOWING INFORMAT TITLA  17
     1ION."/)                                                           TITLA  18
      NO=0                                                              TITLA  19
      IF(KKI .EQ. 1) GO TO 14                                           TITLA  20
      IF(PRINT1 .EQ. 0) GO TO 10                                        TITLA  21
      NO=NO+1                                                           TITLA  22
      WRITE(6,30) NO                                                    TITLA  23
   30 FORMAT(17X,I2,".  COMPOUND COMPRESSIBLE FLOW INFORMATION.")       TITLA  24
   10 IF(PRINT2 .EQ. 0) GO TO 11                                        TITLA  25
      NO=NO+1                                                           TITLA  26
      WRITE(6,31) NO                                                    TITLA  27
   31 FORMAT(17X,I2,".  SURFACE HEAT TRANSFER INFORMATION.")            TITLA  28
   11 IF(PRINT3 .EQ. 0) GO TO 12                                        TITLA  29
      NO=NO+1                                                           TITLA  30
      WRITE(6,32) NO                                                    TITLA  31
   32 FORMAT(17X,I2,".  AVERAGE SURFACE HEAT TRANSFER COEFFICIENTS.")   TITLA  32
   12 IF(PRINT4 .EQ. 0) GO TO 13                                        TITLA  33
      NO=NO+1                                                           TITLA  34
      WRITE(6,33) NO                                                    TITLA  35
   33 FORMAT(17X,I2,".  AVERAGE SYSTEM GAS TEMPERATURES.")              TITLA  36
   13 IF(PRINT5 .EQ. 0) GO TO 41                                        TITLA  37
      NO=NO+1                                                           TITLA  38
      WRITE(6,34) NO                                                    TITLA  39
   34 FORMAT(17X,I2,".  SURFACE COOLING INFORMATION.")                  TITLA  40
   41 IF(PRINTO .EQ. 0) GO TO 14                                        TITLA  41
      NO=NO+1                                                           TITLA  42
      WRITE(6,40) NO                                                    TITLA  43
   40 FORMAT(17X,I2,".  SYSTEM SURFACE FORCE FACTOR CALCULATIONS.")     TITLA  44
   14 IF(PRINT6 .EQ. 0) GO TO 15                                        TITLA  45
      NO=NO+1                                                           TITLA  46
      WRITE(6,35) NO                                                    TITLA  47
   35 FORMAT(17X,I2,".  SYSTEM INTERNAL VIEW FACTORS.")                 TITLA  48
   15 IF(PRINT7 .EQ. 0) GO TO 16                                        TITLA  49
      NO=NO+1                                                           TITLA  50
      WRITE(6,36) NO                                                    TITLA  51
   36 FORMAT(17X,I2,".  SYSTEM WALL TEMPERATURES.")                     TITLA  52
   16 IF(PRINT8 .EQ. 0) GO TO 17                                        TITLA  53
      NO=NO+1                                                           TITLA  54
      WRITE(6,37) NO                                                    TITLA  55
   37 FORMAT(17X,I2,".  SYSTEM EXTERNAL VIEW FACTORS.")                 TITLA  56
   17 NO=NO+1                                                           TITLA  57
      WRITE(6,38) NO                                                    TITLA  58
```

```
   38    FORMAT(17X,I2,".  SYSTEM RADIATION PATTERNS.")                 TITLA    59
         NO=NO+1                                                        TITLA    60
60       WRITE(6,39) NO                                                 TITLA    61
   39    FORMAT(17X,I2,".  SYSTEM RADIATION LEVEL BANDWIDTHS.")         TITLA    62
         RETURN                                                         TITLA    63
         END                                                            TITLA    64
```

```
      OVERLAY(XRHP,1,8)                                                  INPUT$  2
      PROGRAM INPUT                                                      INPUT$  3
C                                                                        INPUT$  4
*  INP                                                                   INPUT$  5
      COMMON/INP/ D,DDZ,DX,DTST,DZ,NANGSEG,NEXIT,  RAYPNT,  ZTST         INPUT$  6
*  GEO                                                                   INPUT$  7
      COMMON /GEO/                                                       INPUT$  8
     1  AB,      AL,      BB,      DDS,       NEN,     NP,               INPUT$  9
     2  RI,      RBO,     RBZ,     REN(18),   RF,      RO,               INPUT$ 10
     3  ROZ,     RP,      RPZ,     SC,        SS,      TANA,             INPUT$ 11
     4  TNB,     TANP,    XC,      XEN(16),   XF,      KO,               INPUT$ 12
     5  XP,      RENO                                                    INPUT$ 13
*   PLM   *                                                              INPUT$ 14
      COMMON/PLM/PLMGD(43),RCN,ST(58),NRD(58),PLM(5,38,58),NFLW,PA,PB,   INPUT$ 15
     1  DPDY,KDATA,ISHK,JSHK,TANE,EQR                                    INPUT$ 16
      DIMENSION YY(50)                                                   INPUT$ 17
      EQUIVALENCE (NOFLOW,NFLW),(XY(1),ST(1))                            INPUT$ 18
*  OBST                                                                  INPUT$ 19
      COMMON /OBST/ HL(10), HU(10),                                      INPUT$ 20
     1  NRG,EXTRA(15),AMS(5),AME(5)                                      INPUT$ 21
     2, NO,      KO                                                      INPUT$ 22
     * ,         XI(5),XE(5),OI(5),OE(5),WI(5),WE(5)                     INPUT$ 23
      DIMENSION XENREN(4),XPR(4)                                         INPUT$ 24
      DIMENSION NU(300),DNU(300)                                         INPUT$ 25
      REAL NUINC                                                         INPUT$ 26
      COMMON/CHUCK/NT,NA,NFREQ,NU,NUFRST,NUINC,DNU                       INPUT$ 27
      COMMON/STAN/ALTOBS(5),ALTPLM,RANGE(5),IATMO,TBB,CSD(4),TBACK       INPUT$ 28
      COMMON/ATMO/NATMO,NRANG,ASPDEG                                     INPUT$ 29
      COMMON/WALT/ITYPE,ITAU,IL,DZZ,ABB,CSS(4)                           INPUT$ 30
      COMMON/SPATIAL/ISPAT                                               INPUT$ 31
      COMMON/EXTEMS/EAREA(20),ETEMP(20),NEXT,XCC,SEXT(5,1)               INPUT$ 32
      COMMON/FILTR/IFILTER,BFILTR(300)                                   INPUT$ 33
      COMMON /CUT/ AX(20), ATX(20), AAB(28), NANG,  IHOT                 INPUT$ 34
      COMMON /EXIT/ EXIT(6)                                              INPUT$ 35
      COMMON /ICHEK/ ICHECK                                              INPUT$ 36
      COMMON/GAS/IRADCK                                                  INPUT$ 37
      DIMENSION AB(5),AC(5)                                              INPUT$ 38
      LOGICAL TERM                                                       INPUT$ 39
      DATA AB/1.9,3.75,3.4,2.6,2.5/                                      INPUT$ 40
      DATA AC/4.1,4.85,5.6,4.8,4.7/                                      INPUT$ 41
      NAMELIST/CASE/                                                     INPUT$ 42
     1  ABB,      AL,      ALTOBS,  ALTPLM,  AMF,      AMI,              INPUT$ 43
     2  ASPDEG,   DDS,     EAREA,   ETEMP,   IFILTER,  IL,               INPUT$ 44
     3  IRADCK,   ISPAT,   ITAU,    ITYPE,   KDATA,    NA,               INPUT$ 45
     4  NANGSEG,  NATMO,   NEXIT,   NEXT,    NFLW,     NP,               INPUT$ 46
     5  NRANG,    NUINC,   RANGE,   RAYPNT,  TBACK,    TBB,              INPUT$ 47
     6  TERM,     NUFRST,  RPN, RTE, ANL, RSN, XP,  RP                   INPUT$ 48
C  ASPDEG  ASPECT ANGLE IN DEGREES                                       INPUT$ 49
C  AL      AXIAL CALCULATION LIMIT  FT                                   INPUT$ 50
C  AMF     BAND FINISH  MICRONS                                          INPUT$ 51
C  AMI     BAND INCEPTION  MICRONS                                       INPUT$ 52
C  DDS     NUMBER OF RAY SEGMENTS                                        INPUT$ 53
C  RPN     RADIUS OF THE PRIMARY NOZZLE.                                 INPUT$ 54
C  RTE     RADIUS AT THE TURBINE EXIT.                                   INPUT$ 55
C  ANL     AXIAL NOZZLE LENGTH.                                          INPUT$ 56
C  RSN     RADIUS OF THE SECONDARY NOZZLE,                               INPUT$ 57
C  XP      EXTENSION LENGTH OF THE NOZZLE PLUG BEYOND THE NOZZLE PLANE.  INPUT$ 58
```

```
C  RP       RADIUS OF THE NOZZLE PLUG AT THE NOZZLE EXIT PLANE.        INPUTS   59
C  KDATA    PLUME PRINT OPTION                                         INPUTS   60
C  RAYPRT   PRINT GAS PARAMETERS ALONG RAY                             INPUTS   61
C  NA       NUMBER OF ATMOSPHERIC SEGEMNTS IN RAY                      INPUTS   62
C  NUINC    STEP SIZE OF RADIATION CALCULATIONS,  CM-1                 INPUTS   63
C  ALTOBS(N)  ALTITUDE OF SENSOR  FT                                   INPUTS   64
C  ALTPLM   ALTITUDE OF VEHICLE  FT                                    INPUTS   65
C  RANGE(N)    RANGE FOR EACH SENSOR ALTITUDE  FT                      INPUTS   66
C   TBB(N)     BLACK BODY TEMP DEG K                                   INPUTS   67
C   TBACK      BACKGROUND TEMP DEG K                                   INPUTS   68
C  NATMO    ATMOSPHERIC TYPE                                           INPUTS   69
C  NRANG    NUMBER OF RANGES                                           INPUTS   70
C  IL       SPECTRAL PRINT OPTION FOR EACH RAY                         INPUTS   71
C  ABB(N)   AREA OF BLACK BODY RADIATOR  SQ CM                         INPUTS   72
C  ITYPE                                                               INPUTS   73
C  ITAU     SPECTRAL PRINT OF TOTAL PLUME                              INPUTS   74
C                                                                      INPUTS   75
      IF(NOFLOW.EQ.0) ICHECK=0                                         INPUTS   76
         IF(NOFLOW.EQ.0) ANL=RSN=0.                                    INPUTS   77
      XENREN(1)=XEN(1)                                                 INPUTS   78
      XENREN(2)=REN(1)                                                 INPUTS   79
      XENREN(3)=XEN(2)                                                 INPUTS   80
      XENREN(4)=REN(2)                                                 INPUTS   81
      XENREN(5)=0.                                                     INPUTS   82
      XENREN(6)=REN(3)                                                 INPUTS   83
      AMI=AMS(1)                                                       INPUTS   84
      AMF=AMS(1)                                                       INPUTS   85
      TERM=.FALSE.                                                     INPUTS   86
      AL=1300.                                                         INPUTS   87
      IF(IHOT.NE.1)  GO TO 278                                         INPUTS   88
      RSN=EXIT(1)                                                      INPUTS   89
      RPN=EXIT(2)                                                      INPUTS   90
      RF=EXIT(3)                                                       INPUTS   91
      XP=EXIT(4)                                                       INPUTS   92
      ANL=EXIT(5)                                                      INPUTS   93
      RTE=EXIT(6)                                                      INPUTS   94
  278 READ(5,CASE)                                                     INPUTS   95
         IF(NFLW.EQ.0) WRITE(6,CASE)                                   INPUTS   96
      IF(IHOT.LT.1)  GO TO 691                                         INPUTS   97
      ICHECK=ICHECK+1                                                  INPUTS   98
      IF(ICHECK.GT.NANG)  GO TO 3788                                   INPUTS   99
      ABB=AX(ICHECK)                                                   INPUTS  100
      TBB=ATX(ICHECK)                                                  INPUTS  101
      ASPDEG=AAB(ICHECK)                                               INPUTS  102
  691 CONTINUE                                                         INPUTS  103
      IF(TERM) GO TO 3700                                              INPUTS  104
      AMS(2)=AL                                                        INPUTS  105
      IF(NOFLOW.EQ.1) GO TO 801                                        INPUTS  106
         IF(ANL.EQ.0.) GO TO 698                                       INPUTS  107
      XENREN(1)=-ANL/12.0                                              INPUTS  108
      XENREN(2)=RTE/12.0                                               INPUTS  109
      XENREN(3)=0.                                                     INPUTS  110
      XENREN(4)=RPN/12.0                                               INPUTS  111
      XENREN(5)=0.                                                     INPUTS  112
         IF(RSN.EQ.0.) RSN=RPN                                         INPUTS  113
      XENREN(6)=RSN/12.0                                               INPUTS  114
      XP=XP/12.0                                                       INPUTS  115
```

```
      RP=RP/12.0
  690 CONTINUE
      IF(IFILTER.LE.0) GO TO 400
      AMI=AB(IFILTER)
      AMF=AC(IFILTER)
  400 CONTINUE
      IF(ISPAT.GT.0) WRITE (8) NRANG
      IF(ISPAT.GT.0) WRITE (8) (RANGE(I),I=1,NRANG)
      DO 101 I=1,NRANG
      ALTOBS(I)=ALTOBS(I)*30.48
  101 RANGE(I)=RANGE(I)*30.48
      PLHGJ(I)=ALTPLM
      ALTPLM=ALTPLM*30.48
      IF(IPAOCK.GT.0) GO TO 802
  801 CONTINUE
      WRITE(6,5000)
      AB=ASPDEG
      IF(NOFLOW.EQ.1) GO TO 802
C
C
      NEN=2
      N=2*NEN+2
      DO 210 I=1,N,2
      J = ( I +1 ) / 2
      XEN(J) = XENREN(I)
  200 REN(J) = XENREN(I +1 )
  210 CONTINUE
  595 WRITE( 06, 2002 )       ( XEN(I), REN(I), I=1,NEN)
         IF(XP.LE.0.) GO TO 195
      XF=XP
      RF=RP
      TANP=RF/XF
      WRITE(6,2001) XP,RP
  195 CONTINUE
      R8=REN(NEN)
      B8=2.*R8
  802 CONTINUE
      WRITE(6,2600)
      IF(NOFLOW.EQ.1) GO TO 800
      AMS(1)=AMI
      AME(1)=AMF
  800 WRITE(6,2800) AMS(1),AME(1),ASPDEG
C
    5 CONTINUE
C
      GO TO 3800
 3700 STOP
C
 2001 FORMAT(/1X ,18H** PLUG DEFINITION//
     120X,36HAXIAL                  RADIAL     (FEET)//
     25(5X,2F20.4/))
 2002 FORMAT(1X,    20H** ENGINE DEFINITION//
     120X,36HAXIAL                  RADIAL     (FEET)//
     210(5X,2F20.4/))
 2600 FORMAT(2X,18H** CASE DEFINITION//
     1)
 2800  FORMAT(/2X,10HWAVELENGTH,2F15.4,6H MICRONS/
```

```
                   22X,10HASP ANGLE ,F15.4,2X,7HDEGREES )                    INPUTS    173
             5000 FORMAT(1H1,26X,21H* * * A S D I R * * *//                  INPUTS    174
                   129X,14HPLUME ANALYSIS//)                                 INPUTS    175
  175        3000 CONTINUE                                                   INPUTS    176
                  END                                                        INPUTS    177
```

```
      OVERLAY(XRHP,2,0)
      PROGRAM ALPLUM
      COMMON/LINK2/ A1,ND,ND2
*  GEO
      COMMON /GEO/
     1  AS,      AL,      BB,      DDS,      NEM,     NP,
     2  RS,      RBD,     RBZ,     REN(10),  RF,      RO,
     3  ROZ,     RP,      RPZ,     SG,       SS,      TANA,
     4  TNB,     TANP,    XC,      XEN(10),  XF,      XO,
     5  XP,      PEND
*  TAB
      REAL NU
      DIMENSION NU(300),DNU(300)
      DIMENSION WEA(3)
      COMMON/CHUCK/NF,NA,NFREQ,NU,NUFRST,NUINC,DNU
      COMMON/LOS/DY(50),XT(50),P1(50),P2(50),P3(50)
      COMMON/OBST/XTRA(20),NRG,XXTRA(15),AMI(5),AME(5),YTRA(2)
      COMMON/WALY/ITYPE,ITAU,IL,DA,ABB(5)
      COMMON/STAN/ALTOBS(5),ALTPLM,XRANGE(5),IATMO,TBB(5),TBACK
      COMMON/ATMC/NATMC,NRANG,ASPDEG
      COMMON/BETAK1/COEF(7,678)
      COMMON/BETAK/ARK(2030)
      COMMON/SSIG/SPSIG(1,5,300)
      COMMON/SPATIAL/ISPAT
      COMMON/SIG/SGAS(5,1),SAMTL(5,1),SMTL(5,1),SBGR(5,1)
      COMMON/EXTENS/EAREA(20),ETEMP(20),NEXT,KCC,SEXT(5,1)
      COMMON/FILSIG/FHP(5),FAMP(5),FGAS(5),FBG(5),FEXT(5)
      COMMON/FILTR/IFILTER,BFILTR(300)
      COMMON/GAS/IRADCK
*  RAY
      COMMON/RAY/
     1  ADS,   ATST,   AQA,   DD,   DS,   L1
*  INP
      COMMON /INP/
     1 D,  DDZ,  DX,  DTST,  DZ,  NDZ,  NOP,  NPRINT,  ZTST
      DATA WEA/3HDRY,4HNOR.,3HWET/
      NTWO=0
      ASPDEG=A8
      DO 50 I=1,5
      DO 51 J=1,300
   51 SPSIG(1,I,J)=0.
      SGAS(I,1)=0.
      SAMTL(I,1)=0.
      FHP(I)=0.
      FAMP(I)=0.
      FGAS(I)=0.
      FBG(I)=0.
      FEXT(I)=0.
      SEXT(I,1)=0.
      SMTL(I,1)=0.
   50 SBGR(I,1)=0.
      IF(IRADCK.LE.0) GO TO 151
      CALL PLURAY
      IF(IRADCK.EQ.2) KCC=1
      CALL PLUSIG
      GO TO 150
  151 CONTINUE
```

```
C
      IEND=0
C     RETURN FOR NEW DZ PLANE
C     INITIALIZE FOR COMPONENT CALCULATIONS
  280 CALL RAYCAL(IEND)
      IF(IEND.EQ.1000) GO TO 638
      DDS=ADS
      RPZ=RF**2-DZ**2
      IF(RPZ.LT.0.) RPZ=0.
      RPZ=SQRT(RPZ)
  290 BZ=B3**2-(2.*DZ)**2
      IF(BZ.LT.0.) BZ=0.
  285 BZ=SQRT(BZ)
      RBZ=BZ/2.
C
C     ESTABLISH STARTING VALUES
C
      IF(A*.EQ.0..OR.A8.EQ.180.) GO TO 360
      IF(A8.EQ.90.) GO TO 361
      IF(D.LT.XC) GO TO 360
      IF(ADS.GT.8.) ADS=ADS/2.
      GO TO 360
  361 DCHK=ABS(XC *TANA)
      IF(D.LT.DCHK) GO TO 360
      IF(ADS.GT.8.) ADS=ADS/2.
C
  360 DDS=ADS
      CALL PLURAY
      AQ=1.
      NE=DDS
      IF(L1.EQ.0) AQ=8.
      DA=AQA*AQ
      IF(DA.EQ.0.) GO TO 612
      XCC=0.
      IATMO=0
      IF(DZ.EQ.0..AND.D.EQ.0.) IATMO=1
      NTWO=NTWO+1
      IF(NTWO.EQ.1) XCC=1.
      IF(NEXT.EQ.0) XCC=0.
      CALL PLUSIG
  612 AQ=1
      GO TO 280
  638 CONTINUE
      DO 102 J=1,NRG
      DO 102 I=1,NPANG
      RANGE=XRANGE(I)/1.0E+5
      ALT=ALTPLM/1.0E+5
      ALO=ALTOBS(I)/1.0E+5
      WRITE(6,101) AMI(J),AME(J),RANGE,ASPDEG,WEA(NATMO)
      WRITE(6,107) ALT,ALO
      IF(ITAU.LT.0) GO TO 100
      WRITE(6,103)
      DO 104 II=1,NFREQ
      K=NFREQ+1-II
      SNJ=NU(K)
      DSNJ=DNU(K)
      WL=1.E4/SNJ
```

```
      XWW=1.E4/(SNU+1.)
      XWW=(XWL-XWW)*DSNU
      RWL=SPSIG(1,I,K)*SNU*SNU*1.E-4/DNU(K)
  101 WRITE(6,105) XWL,XWW,SPSIG(1,I,K),SNU,DSNU,RWL
  101 SNU=SAMTL(I,1)+SGAS(I,1)-SBGR(I,1)
      SNU=SNU+SEXT(I,1)
      WRITE(6,106) ABB(1),TBB(1),TBACK,SNU,SAMTL(I,1),SMTL(I,1),
     1SGAS(I,1),SBGR(I,1)
      IF(NEXT.NE.0.) WRITE(6,108) SEXT(I,1)
      IF(IFILTER.EQ.0) GO TO 102
      WRITE(6,109) IFILTER
      IF(ITAU.LT.0) GO TO 402
      WRITE(6,103)
      DO 401 II=1,NFREQ
      K=NFREQ+1-II
      SNU=NU(K)
      DSNU=DNU(K)
      XWL=1.E+4/SNU
      SSS=SPSIG(1,I,K)*BFILTR(K)
      XWW=1.E+4/(SNU+1.)
      XWW=(XWL-XWW)*DSNU
      RWL=SPSIG(1,I,K)*SNU*SNU*1.E-4*BFILTR(K)/DNU(K)
  401 WRITE(6,105) XWL,XWW,SSS,SNU,DSNU,RWL
  402 SNU=FAMP(I)+FGAS(I)-FBG(I)+FEXT(I)
      WRITE(6,106) ABB(1),TBB(1),TBACK,SNU,FAMP(I),FMP(I),FGAS(I),FBG(I)
      IF(NEXT.NE.0) WRITE(6,108) FEXT(I)
  102 CONTINUE
  101 FORMAT(1H0///6X,3H***,*TOTAL SIGNATURE OVER THE SPECTRAL BAND *,
     **F4.2,* TO *,F4.2,* MICRONS AT A RANGE OF *,F10.3,* KM*/6X,*FOR AN
     *ASPECT ANGLE OF *,F5.1,* DEGREES IN A *,A4,* ATMOSPHERE*,3H***/1H0
     *)
  103 FORMAT(1H0,9X,*BAND CENTER   BAND WIDTH  APPARENT RADIANCE    WAVEN
     *UMBER   INCREMENT    SPECTRAL RADIANCE*/12X,*MICRONS      MICRONS
     *    WATTS/STERADIAN    (CENTER)CM-1     CM-1        WATTS/MICRON/SR*/)
  105 FORMAT(12X,F6.4,7X,F6.4,7X,F12.4,5X,F10.2,5X,F5.1,5X,F12.4)
  106 FORMAT(1H0,3X*PLUME POINT-SOURCE SIGNATURE*/
     CT20*EFFECTIVE BLACK BODY AREA - ABB = *F10.4*  CMSQ*/
     CT20*EFFECTIVE BB TEMPERATURE -  TBB = *F10.4*  DEGK*/
     CT20*EFFECTIVE BACKGROUND TEMP.-TBACK= *F10.4*  DEGK*/
     CT20*APPARENT RADIANCE = *F10.4*  WATTS/STERADIAN*/
     CT20*ATTENUATED METALS = *F10.4*  WATTS/STERADIAN*/
     CT20*METALS            = *F10.4*  WATTS/STERADIAN*/
     CT20*PLUME GAS SPECIES = *F10.4*  WATTS/STERADIAN*/
     CT20*BACKGROUND        = *F10.4*  WATTS/STERADIAN*)
  107 FORMAT(6X,1H*,*VEHICLE ALTITUDE = *,F6.2,* KM AND OBSERVER ALTITUD
     1E = *,F6.2,* KM*)
  108 FORMAT(18X,*EXTERNAL EMISSIONS = *,F10.4)
  109 FORMAT(1H0///6X,3H***,*TOTAL FILTERED SIGNATURE FOR FILTER # *,I1)
  150 CONTINUE
      END
```

```
      SUBROUTINE RAYCAL(IEND)                                          RAYCAL   2
      DIMENSION ROZ(200), ROD(200), RAR(200)                           RAYCAL   3
      COMMON/GEO/                                                      RAYCAL   4
     1 AB,   AL,   BB,   ODS,   NEN,   NP,                             RAYCAL   5
     2 RB,   RBO,   RBZ,   REN(10),   RF,   RO,                        RAYCAL   6
     3  ROZ,      RP,      RPZ,      SC,      SS,      TANA,           RAYCAL   7
     4 TNB,TANP,   XC,   XEN(10),   XF,   XO,                          RAYCAL   8
     5  XP,       REND                                                 RAYCAL   9
      COMMON/INP/ D,DDZ,DX,DIST,DZ,NANGSEG,NEXIT,  RAYPNT,  ZTST       RAYCAL  10
      COMMON/SPATIAL/ISPAT                                             RAYCAL  11
      IF(IEND.NE.1) GO TO 12                                           RAYCAL  12
      ANGSEG=FLOAT(NANGSEG)                                            RAYCAL  13
      EXIT=FLOAT(NEXIT)                                                RAYCAL  14
      DELR=2.*RB/EXIT                                                  RAYCAL  15
      PIE=3.14159                                                      RAYCAL  16
      DRAD=57.29577                                                    RAYCAL  17
      NESEG=NANGSEG                                                    RAYCAL  18
      RD=ANGSEG-1.5                                                    RAYCAL  19
      K=0                                                              RAYCAL  20
      COST=ABS(COS(AB/DRAD))                                           RAYCAL  21
      GAMA=(REND-RB)/AL                                                RAYCAL  22
      RCOR=RB/GAMA                                                     RAYCAL  23
      GAMB=ATAN(GAMA)                                                  RAYCAL  24
C  FIRST PASS                                                          RAYCAL  25
      IF(AB.EQ.0..OR.AB.EQ.180.) GO TO 40                              RAYCAL  26
      IF(AB.EQ.90.) GO TO 70                                           RAYCAL  27
C  FOR 0<AB<90                                                         RAYCAL  28
      TANB=ABS(TANA)                                                   RAYCAL  29
      RBPJT=ABS(RB/TANA)                                               RAYCAL  30
      DIST=ABS(AL*TANA)                                                RAYCAL  31
      NCORE=INT(XC/RBPJT)                                              RAYCAL  32
      NCORF=NEXIT                                                      RAYCAL  33
      IF(NCORE.GT.NCORF) NCORE=NCORF                                   RAYCAL  34
      CORE=FLOAT(NCORE)                                                RAYCAL  35
      ZZZ=RBPJT                                                        RAYCAL  36
      IF(CORE.EQ.0.) GO TO 5                                           RAYCAL  37
      DRB=(XC-RBPJT)/CORE                                              RAYCAL  38
      ZZZ=XC                                                           RAYCAL  39
    5 DAL=(AL-ZZZ)                                                     RAYCAL  40
      IF(AB.GT.90.) GO TO 14                                           RAYCAL  41
      RB=180./ANGSEG                                                   RAYCAL  42
      D=-DELR*(EXIT-1)/2.                                              RAYCAL  43
      DO 1 I=1,NEXIT                                                   RAYCAL  44
      R1=D+DELR/2.                                                     RAYCAL  45
      R2=D-DELR/2.                                                     RAYCAL  46
      AREA=PIE*RB*(R1**2-R2**2)/360.                                   RAYCAL  47
      AREA=2.*ABS(AREA)                                                RAYCAL  48
      IF(D.EQ.0.) AREA=PIE*DELR*DELR/2.                                RAYCAL  49
      DO 6 J=1,NESEG                                                   RAYCAL  50
      K=K+1                                                            RAYCAL  51
      AREB=AREA                                                        RAYCAL  52
      IF(J .EQ.1 ) AREB=AREA/2.                                        RAYCAL  53
      RAR(K)=AREB*COST                                                 RAYCAL  54
      IF(D.EQ.0.) GO TO 7                                              RAYCAL  55
      THETA=(J-1)*RB/DRAD                                              RAYCAL  56
      ROZ(K)=ABS(D)*SIN(THETA)                                         RAYCAL  57
    6 ROD(K)=D*COS(THETA)                                              RAYCAL  59
```

```
      GO TO 8                                                   RAYCAL  59
    7 RDZ(K)=RDD(K)=0.                                          RAYCAL  60
    8 CONTINUE                                                  RAYCAL  61
      D=D+DELR                                                  RAYCAL  62
      IF(ABS(D).LT.1.E-10) D=0.0                                RAYCAL  63
    1 CONTINUE                                                  RAYCAL  64
      GO TO 15                                                  RAYCAL  65
   14 D=-BPJT                                                   RAYCAL  66
      DELR=0.                                                   RAYCAL  67
      N9=0                                                      RAYCAL  68
      GO TO 16                                                  RAYCAL  69
   15 N9=NEXIT                                                  RAYCAL  70
   16 CONTINUE                                                  RAYCAL  71
      IF(NCORE.EQ.0) GO TO 3                                    RAYCAL  72
      D=D-(DELR-DR8)/2.                                         RAYCAL  73
      DO 2 I=1,NCORE                                            RAYCAL  74
      RB=GAMB*DRAD/RD                                           RAYCAL  75
      R1=D+DR8/2.+RCOR                                          RAYCAL  76
      R2=D-DR8/2.+RCOR                                          RAYCAL  77
      AREA=PIE*RB*(R1**2-R2**2)/360.                            RAYCAL  78
      DO 9 J=1,NESEG                                            RAYCAL  79
      K=K+1                                                     RAYCAL  80
      XY=2.                                                     RAYCAL  81
      THETA=J                                                   RAYCAL  82
      THETA=(THETA-1.)*RB/DRAD                                  RAYCAL  83
      RDZ(K)=(D+RCOR)*SIN(THETA)                                RAYCAL  84
      RDD(K)=((D+RCOR)*COS(THETA)-RCOR)*TANB                    RAYCAL  85
      IF(J.EQ.1) XY=1.                                          RAYCAL  86
    9 RAR(K)=AREA*XY*TANB*COST                                  RAYCAL  87
      D=D+DR8                                                   RAYCAL  88
    2 CONTINUE                                                  RAYCAL  89
      DXYZ=0.                                                   RAYCAL  90
      D=D-DR8/2.                                                RAYCAL  91
      GO TO 4                                                   RAYCAL  92
    3 D=D-DELR/2.                                               RAYCAL  93
    4 NTWO=NEXIT                                                RAYCAL  94
      DIV=NTWO                                                  RAYCAL  95
      RB=GAMB*DRAD/RD                                           RAYCAL  96
      DAL=DAL/DIV                                               RAYCAL  97
      DELR=RCOR+ZZZ                                             RAYCAL  98
      DEL=DELR                                                  RAYCAL  99
      DYL=DAL                                                   RAYCAL 100
      DAL=0.                                                    RAYCAL 101
      DO 111 I=1,NTWO                                           RAYCAL 102
      DAL=DAL+DYL                                               RAYCAL 103
      R1=DAL+DEL                                                RAYCAL 104
      R2=DELR                                                   RAYCAL 105
      DELTA=(R1-R2)/2.                                          RAYCAL 106
      AREA=PIE*(R1**2-R2**2)*RB/360.                            RAYCAL 107
      DELR=R1                                                   RAYCAL 108
      D=R2+DELTA                                                RAYCAL 109
      DO 111 J=1,NESEG                                          RAYCAL 110
      K=K+1                                                     RAYCAL 111
      XY=2.                                                     RAYCAL 112
      THETA=J                                                   RAYCAL 113
      THETA=(THETA-1.)*RB/DRAD                                  RAYCAL 114
      RDZ(K)=D*SIN(THETA)                                       RAYCAL 115
```

```
      RDD(K)=(D*COS(THETA)-RCOR)*TANB                                  RAYCAL
      IF(J.EQ.1) XY=1.                                                 RAYCAL
  111 RAR(K)=AREA*XY*TANB*COST                                         RAYCAL
      GO TO 20                                                         RAYCAL
   40 DAL=REND-R8                                                      RAYCAL
      DIV=1.                                                           RAYCAL
      DO 41 I=1,NEXIT                                                  RAYCAL
      DI=I                                                             RAYCAL
   41 DIV=DIV*DI                                                       RAYCAL
      NDIV=(NEXIT-1)/2                                                 RAYCAL
      DAL=DAL/DIV                                                      RAYCAL
      IF(AB.EQ.180.) GO TO 44                                          RAYCAL
      RAR(1)=PIE*DELR*DELR/4.                                          RAYCAL
      RDZ(1)=RDD(1)*0.                                                 RAYCAL
      K=1                                                              RAYCAL
      DO 42 I=1,NDIV                                                   RAYCAL
      K=K+1                                                            RAYCAL
      A=I                                                              RAYCAL
      D=A*DELR                                                         RAYCAL
      R1=D+DELR/2.                                                     RAYCAL
      R2=D-DELR/2.                                                     RAYCAL
      AREA=PIE*(R1**2-R2**2)                                           RAYCAL
      RAR(K)=AREA                                                      RAYCAL
      RDZ(K)=0.                                                        RAYCAL
   42 RDD(K)=D                                                         RAYCAL
   44 DELP=R8                                                          RAYCAL
      DO 43 I=1,NEXIT                                                  RAYCAL
      DAL=DAL*I                                                        RAYCAL
      R1=DAL+R8                                                        RAYCAL
      R2=DELP                                                          RAYCAL
      DELTA=(R1-R2)/2.                                                 RAYCAL
      AREA=PIE*(R1**2-R2**2)                                           RAYCAL
      DELP=R1                                                          RAYCAL
      D=R1-DELTA                                                       RAYCAL
      K=K+1                                                            RAYCAL
      RDD(K)=D                                                         RAYCAL
      RDZ(K)=0.                                                        RAYCAL
   43 RAR(K)=AREA                                                      RAYCAL
      GO TO 20                                                         RAYCAL
   70 RB=GAMB*DRAD                                                     RAYCAL
      DXYZ=R8*RCOR/2.                                                  RAYCAL
      DXYZ=DXYZ-PIE*R3*RCOR**2/360.                                    RAYCAL
      RB=R3/RD                                                         RAYCAL
      NCORE=NEXIT                                                      RAYCAL
      CORE=NCORE                                                       RAYCAL
      DR=0.                                                            RAYCAL
      XL=0.                                                            RAYCAL
      IF(CORE.EQ.0.) GO TO 71                                          RAYCAL
      XL=XC                                                            RAYCAL
      DELR=XC/CORE                                                     RAYCAL
      DO 72 I=1,NCORE                                                  RAYCAL
      DR=DR+DELR+RCOR                                                  RAYCAL
      D=DR-DELR/2.-RCOR                                                RAYCAL
      R1=DR**2                                                         RAYCAL
      R2=(DR-DELR)**2                                                  RAYCAL
      AREA=R3*(R1-R2)*PIE/360.                                         RAYCAL
      DR=DR-RCOR                                                       RAYCAL
```

```
      DO 72 J=1,NESEG
      K=K+1
      THETA=J
      THETA=(THETA-1.)*RB/DRAD
      ROZ(K)=(D+RCOR)*SIN(THETA)
      ROD(K)=(D+RCOR)*COS(THETA)-RCOR
      AREB=AREA
      IF(I.EQ.1.AND.J.EQ.NESEG) AREB=AREB-DXYZ
      XY=2.
      IF(J.EQ.1) XY=1.
   72 RAR(K)=AREB*XY
      DR=XC
   71 DAL=AL-DR
      NTWO=NEXIT
      DIV=NTWO
      DAL=DAL/DIV
      DELR=XL+RCOR
      DYL=DAL
      DAL=0.
      DO 74 I=1,NTWO
      DAL=DAL+DYL
      R1=DAL+XL+RCOR
      R2=DELR
      DELTA=(R1-R2)/2.
      AREA=PIE*RB*(R1**2-R2**2)/360.
      DELR=R1
      D=R1-DELTA
      DO 74 J=1,NESEG
      K=K+1
      THETA=J
      THETA=(THETA-1.)*RB/DRAD
      ROZ(K)=D*SIN(THETA)
      ROD(K)=D*COS(THETA)-RCOR
      AREB=AREA
      XY=2.
      IF(J.EQ.1) XY=1.
   74 RAR(K)=AREB*XY
   28 IEND=0
      IF(ISPAT.LE.0) GO TO 12
      WRITE (8) RB,REND,XC,AL,RCOR
      WRITE (8) K
      DO 100 I=1,K
      A=RAR(I)*30.48*30.48
      B=ROD(I)
      C=ROZ(I)
  100 WRITE (8) A,B,C
   12 IEND=IEND+1
      IF(IEND.GT.K) GO TO 25
      DDZ=RAR(IEND)*144.
      D=ROD(IEND)
      DZ=ROZ(IEND)
      RETURN
   25 IEND=1000
      RETURN
      END
```

```
      SUBROUTINE PLURAY                                                  PLURAY$   2
*     GEO                                                                PLURAY$   3
      COMMON /GEO/                                                       PLURAY$   4
     1  AB,        AL,       BB,       DDS,       MEN,       NP,         PLURAY$   5
     2  RB,        RBO,      RBZ,      REN(10),   RF,        RO,         PLURAY$   6
     3  ROZ,       RP,       RPZ,      SC,        SS,        TAMA,       PLURAY$   7
     4  TNB,       TAMP,     XC,       XEN(10),   XF,        XO,         PLURAY$   8
     5  XP,        REND                                                  PLURAY$   9
*     MICRON                                                             PLURAY$  10
*     RAY                                                                PLURAY$  11
      COMMON/RAY/                                                        PLURAY$  12
     1  ADS,  ATST,  AOA,  DD,  DS,  N1                                  PLURAY$  13
*     INP                                                                PLURAY$  14
      COMMON /INP/                                                       PLURAY$  15
     1 D,  DDZ,  DX,  DTST,  DZ,  NDZ,  NDP,  RAYPNT,  ZTST              PLURAY$  16
*     OBST                                                               PLURAY$  17
      COMMON /OBST/ HL(10), HU(10),                                      PLURAY$  18
     1  NRG,       TA3(5),   TA4(5),   TGB(5),   AMI(5), AME(5)          PLURAY$  19
     2, NO,        KO                                                    PLURAY$  20
      COMMON/LOS/DY(50),XT(50),P1(50),P2(50),P3(50)                      PLURAY$  21
      COMMON/GAS/IRADCK                                                  PLURAY$  22
      DIMENSION O(4),GG(4)                                               PLURAY$  23
C                                                                        PLURAY$  24
C     ROUTINE TO GENERATE PARAMETERS DESCRIBING THE PLUME RAY.           PLURAY$  25
C     RETURNS THE FOLLOWING ARGUMENTS\                                   PLURAY$  26
C       AOA  PROJECTED AREA OF PLUME RAY SQ CM                           PLURAY$  27
C       DY   LENGTH OF EACH RAY SEGMENT CM                               PLURAY$  28
C       XT   STATIC TEMPERATURE OF EACH SEGMENT  DEG K                   PLURAY$  29
C       P1   PARTIAL PRESSURE OF H2O ATM                                 PLURAY$  30
C       P2   PARTIAL PRESSURE OF CO2 ATM                                 PLURAY$  31
C       P3   PARTIAL PRESSURE OF O2 AND N2 ATM                           PLURAY$  32
C       N1   1 IF RAY EXISTS, 0 IF NOT                                   PLURAY$  33
C                                                                        PLURAY$  34
      NAMELIST/STONE/P1,P2,P3,XT                                         PLURAY$  35
      IF(IRADCK.GT.0) GO TO 150                                          PLURAY$  36
      KSTP=DDS                                                           PLURAY$  37
      AO=1.                                                              PLURAY$  38
      N1=1                                                               PLURAY$  39
      DO 805 I=1,4                                                       PLURAY$  40
  805 GG(I)=0.                                                           PLURAY$  41
  368 IF(NO.EQ.0.OR.KO.GT.10) GO TO 362                                  PLURAY$  42
      IF(D.GT.HL(KO).AND.D.LT.HU(KO)) GO TO 656                          PLURAY$  43
      IF(D.GE.HU(KO).AND.(D-ABS(DD)).LT.HU(KO))                          PLURAY$  44
     1AO=AO*(.5+(D-HU(KO))/ABS(DD))                                      PLURAY$  45
      IF(D.LE.HL(KO).AND.(D+ABS(DD)).GT.HL(KO))                          PLURAY$  46
     1AO=AO*(.5+(HL(KO)-D) /ABS(DD))                                     PLURAY$  47
  362 CONTINUE                                                           PLURAY$  48
      CALL START(XO,RBO,DSO)                                             PLURAY$  49
      IF(DSO.EQ.0.) GO TO 656                                            PLURAY$  50
      DS=DSO                                                             PLURAY$  51
C                                                                        PLURAY$  52
C     INITIALIZE FOR EACH RAY                                            PLURAY$  53
                                                                         PLURAY$  54
      CP=DDZ                                                             PLURAY$  55
      ACP=DSO*DDS                                                        PLURAY$  56
  430 AO=AO*CP                                                           PLURAY$  57
      AOA=AO*6.4515                                                      PLURAY$  58
```

```
      IF(RAYPNT.NE.0.) WRITE(6,781) AQA,DZ,XO,R00
      NTP=0
      S=ACP-DSO/2.
C
C     BEGIN  S  LOOP
C
  754 X8=XO+SC*S
      R=SQRT((R80-SS*
      IF(X8.GE.0.) S
      IF(R80.EQ.0.) GO TO 8
      R=R*R8Z/R80
      GO TO 824
  825 R=0.
  824 X8=0.
      GO TO 800
  820 CONTINUE
      IF(R.GT.88) GO TO 800
C
C            DETERMINE AVERAGE FLOW PROPERTIES
C
      GX=.2*DS
      S=S+2.*GX
      LK=1
  850 X8=XO+SC*S
      IF(X8.LT.0.) GO TO 855
      R=SQRT((R80-SS*S)**2+DZ**2)
      CALL INTERP(Q,X8,R,KN)
  855 DO 860 L=1,4
  860 GG(L)=GG(L)+Q(L)
      LK=LK+1
      S=S-GX
      IF(LK.LE.5) GO TO 850
      S=S+3.*GX
      DO 870 L=1,4
      Q(L)=GG(L)/5.
  870 GG(L)=0.
      GO TO 8301
  800 CALL INTERP(Q,X8,R,KN)
 8301 CONTINUE
      Q(2)=Q(2)*Q(4)
      Q(3)=Q(3)*Q(4)
      IF(RAYPNT.EQ.0.) GO TO 830
      WRITE(6,700) X8,R,DSO,Q(1),Q(2),Q(3),Q(4)
      GO TO 830
  150 IF(IRADCK.GT.1) GO TO 1000
      READ(5,STONE)
      AGA=100.
      DY(1)=100.
      WRITE(6,151) P1(1),P2(1),P3(1),XT(1)
  151 FORMAT(6X,*PH2O = *,F6.4,* PCO2 = *,F6.4,* PGAS = *,F6.4,* TEMP =*
     A,F7.2)
      RETURN
C
  830 CONTINUE
  476 NTP=NTP+1
      NER=NTP
      P1(NER)=Q(2)
```

```
                  P2(NER)=Q(3)                                                   PLURAYS   116
                  P3(NER)=Q(4)-Q(2)-Q(3)                                         PLURAYS   117
                  DY(NER)=DSO*30.48                                              PLURAYS   118
                  XT(NER)=Q(1)/1.8                                               PLURAYS   119
                  DS=DSO                                                         PLURAYS   120
            493   S=S-DS                                                         PLURAYS   121
                  IF(NTP.LT.KSTP) GO TO 754                                      PLURAYS   122
                  GO TO 1000                                                     PLURAYS   123
            655   NI=0                                                           PLURAYS   124
           1000   CONTINUE                                                       PLURAYS   125
            760   FORMAT(4X,*(X,Y)=(*,F7.3,1H,,F7.3,*) \DS=*,F6.3,* FT\ T=*,F7.2,  * PLURAYS   126
                 1 DEGR \ (PPH2O,PPCO2,PGAS)=(*,F6.4,1H,,F6.4,1H,,F6.4,*) ATMO*)  PLURAYS   127
            781   FORMAT(1H0,3X,*AVERAGE RAY PROPERTIES\ PROJECTED AREA = *,F10.2,* PLURAYS   128
                 1SQ CM; Z = *,F10.4,* FT*/29X,*XSTART = *,E10.2,* FT; YSTART = *, PLURAYS   129
                 2F10.2,* FT*/1H )                                               PLURAYS   130
                  END                                                            PLURAYS   131
          CSTART                                                                 START       2
```

```
      SUBROUTINE  START( XSTART, YSTART, DS )
*  GEO
      COMMON /GEO/
     1  AB,        AL,        B8,        DOS,       NEN,       NP,
     2  R8,        R8O,       R8Z,       REN(10),   RF,        RO,
     3  ROZ,       RP,        RPZ,       SC,        SS,        TANA,
     4  TN8,       TANP,      XCC,       XEN(10),   XF,        XO,
     5  XP,        RENO
*  INP
      COMMON /INP/
     1 D,  DOZ,  DX,  DTST,  DZ,  NOZ,  NOP,  NPRINT,  ZTST
      EQUIVALENCE( R0, RO ), ( ROZ, ROZ )
      EQUIVALENCE (A8,ALPHA)
C
C  ROUTINE TO PRODUCE STARTING AND ENDING POINTS OF RAY THROUGH
C  PLUME.
C
      TKK=TANA
      TANA=ABS(TANA)
      A180=0.
      DO = ABS( D )
      XSTART=D
      DZSQ = DZ *  DZ
      XZ= RENO**2-DZSQ
      IF(XZ.LE.0.) XZ=0.
      XZ=SQRT(XZ)
      TNBP=(RENO-R8)/AL
      IF(NP.EQ.0) GO TO 1120
      TAP=RPZ/XF
 1120 XC=0.
      IF(DZ.GT.R8) XC=(DZ-R8)/TNBP
      TANB=(XZ-R8Z)/(AL-XC)
   10 IF ( ALPHA - 90. ) 20, 600, 600
   20 IF ( ALPHA .GT. 0.0 )    GO TO 200
C
C             ALPHA .EQ. 0.0
C
   30 YSTART = D
       YFINSH = D
   50 XFINSH = AL
   90 IF (DO .GE. R8Z )    GO TO 115
      IF(A180.EQ.1.) GO TO 115
      IF(RPZ.EQ.0.) GO TO 120
      IF(ABS(D).GE.RPZ) GO TO  120
      XSTART=(RPZ-ABS(D))/TAP
      GO TO 250
  115 XSTART=(DO-R8Z)/TANB+XC
      GO TO 250
  120  R1 = R8Z
  140 DO 210 J =2, NEN
  150 K = NEN - J + 1
      R2 = REN(K) * REN(K) - DZSQ
      R2 = SIGN( SQRT( ABS( R2 ) ) , R2 )
      IF ( R2 .LT. 0.0 )    GO TO 240
      IF (DO .GE. R2 )    GO TO 240
       R1 = R2
  210 CONTINUE
```

```
      XSTART = XEN( 1 )
      GO TO 250
  240 XSTART = (DQ-R2 ) * ( XEN( K+ 1 ) - XEN(K) ) / ( R1 - R2 ) +
     1 XEN(K)
  250 IF(XSTART.GE.AL) GO TO 345
      IF ( XSTART .LT. XEN(1) )   XSTART = XEN( 1 )
      IF ( A100 .EQ. 1. )   GO TO 830
      GO TO 890
C
C              0.0 .LT. ALPHA .LT. 90.
C
  260 IF ( RPZ .LE. 0.0 )   GO TO 340
      XK=0.
      IF(D.GE.RPZ) XK=D/TANA
      IF(XK.GE.XF) GO TO 1104
      IF(-D.GE.RPZ) GO TO 1100
      XSTART=(D+RPZ)/(TANA+TAP)
      GO TO 490
 1100 YSTART=-RPZ
      XSTART=(D+RPZ)/TANA
      GO TO 1103
 1104 IF(D.GE.RPZ) GO TO 340
      XSTART=(D-RPZ)/(TANA/TAP)
      GO TO 490
  340 IF ( DQ .GE. RBZ )   GO TO 500
  350 R1 = RBZ
      DO 430 J =2,NEN
      K = NEN - J + 1
      RO = D - TANA * XEN( K )
      R2 = REN(K) * REN(K) - DZSQ
      R2 = SIGN( SQRT( ABS( R2 ) ) , R2 )
  400  IF ( R2 .LT. 0.0 )   GO TO 460
      IF (RO .GT. R2 )   GO TO 460
      R1 = R2
  430 CONTINUE
      XSTART = XEN(1 )
      GO TO 490
  460 TANE = ( R2 - R1 ) / ( XEN( K) - XEN( K +1 ) )
      XSTART = XEN( K ) + ( RO - R2 ) / ( TANE + TANA )
  490 YSTART = D - XSTART * TANA
 1103 IF(TANA.EQ.TANB) GO TO 508
      XFINSH=(D+RBZ)/(TANA-TANB)
      IF(XFINSH.LT.AL) GO TO 508
      GO TO 509
  500 IF(DZ.GT.RB) GO TO 560
      XSTART=(D-RBZ)/(TANA+TANB)
      YSTART=D-XSTART*TANA
      IF(TANA.EQ.TANB) GO TO 509
      XFINSH=(D+RBZ          )/(TANA-TANB)
      IF(XFINSH.GT.AL) GO TO 509
      GO TO 509
  558 XK=D/TANA
      IF(XK.LT.XC) GO TO 345
  345 XSTART=(XC*TANB+D)/(TANA+TANB)
      YSTART=D-XSTART*TANA
      IF(TANA.EQ.TANP) GO TO 509
```

```
      XFINSH=(D-XC*TANB)/(TANA-TANB)
  517 IF(XFINSH.LT.AL) GO TO 580
  590 XFINSH = AL
  580 YFINSH=D-XFINSH*TANA
      GO TO 890
C
C           ALPHA = 90.
C
  600 IF(RPZ.LE.0.0) GO TO 650
      IF(D.GE.XF) GO TO 650
      YSTART=RBZ+TANB*XSTART
      YFINSH=RPZ-TAP*XSTART
      GO TO 660
  650 YSTART=RBZ+TANB*(XSTART-XC)
      IF(YSTART.GT.0.) GO TO 651
  345 DS=0.
      GO TO 900
  651 YFINSH = -YSTART
  660 XFINSH = XSTART
      GO TO 893
  680 IF ( ALPHA .GE. 180. )   GO TO 820
C
C         90.0 .LT. ALPHA  .LT. 180.0
C
      IF(RPZ.EQ.0.) GO TO 681
      XK=D/TANA
      IF(XK.GE.XF) GO TO 681
      XSTART=(D-RPZ)/(TANA-TAP)
      GO TO 725
  681 TB1=TANB
      IF(DZ.GT.RB) GO TO 891
      IF(TANA.LE.TANB) GO TO 715
      XSTART=(D+RBZ)/(TANA-TANB)
      IF(XSTART.LE.AL) GO TO 725
  715 XSTART=AL
  725 YSTART=D-XSTART*TANA
      XFINSH=(D-RBZ)/(TANA+TANB)
      IF(XFINSH.GT.AL) GO TO 345
      YFINSH=D-XFINSH*TANA
      GO TO 893
  891 XK=D/TANA
      IF(XK.LT.XC) GO TO 345
      IF(TANA.LE.TANB) GO TO 893
      XSTART=(D-XC*TANB)/(TANA-TANB)
      IF(XSTART.LT.AL) GO TO 892
  893 XSTART=AL
  892 YSTART=D-XSTART*TANA
      XFINSH=(D+XC*TANB)/(TANA+TANB)
      IF(XFINSH.GT.AL) GO TO 345
      YFINSH=D-TANA*XFINSH
      GO TO 890
C
C               ALPHA = 180.
C
  820 A130 = 1.
      GO TO 30
  830 A130 = XSTART
```

```
                      YSTART = XFINSH                                                 START      174
                      XFINSH = A180                                                   START      175
                      A180 = 0.                                                       START      176
     175        890   CONTINUE                                                        START      177
                      TANA=TXX                                                        START      178
                895   DS = SQRT ( ( YFINSH - YSTART ) **2 + ( XFINSH - XSTART ) **2 ) START      179
                    1     / DDS                                                       START      180
                      YSTART=ABS(YSTART)                                              START      181
     180        900   RETURN                                                          START      182
                      END                                                             START      183
               CINTERP                                                                INTERP       2
```

```
      SUBROUTINE INTERP( D, X, R, KA )
*     PLM     *
      COMMON/PLM/PLMGJ(43),RCN,ST(50),NRD(50),PLM(5,38,50),NFLM,PA,P8,
     1   DPDX,KDATA,ISHK,JSHK,TANE,EQR
      DIMENSION XY(50),NBX(50),XX(5,38,50)
      EQUIVALENCE (NBX(1),NRD(1)),(XX(1,1,1),PLM(1,1,1)),(XY(1),ST(1))
      DIMENSION D(4)
C
C  ROUTINE TO INTERPOLATE BETWEEN STATIONS ALONG CENTERLINE OF
C  PLUME AND ALONG RADIAL DIMENSION OF PLUME.
C  RETURNS THE FOLLOWING ARGUMENTS\
C    D(1)  STATIC TEMP IN DEGREE R
C    D(2)  MOLE CONCENTRATION OF H2O
C    D(3)  MOLE CONCENTRATION OF CO2
C  D(4)  GAS PRESSURE ATMO
C
      IF(X.LT.XY(49)) GO TO 20
  120 DO 125 I=2,5
      M=I-1
  125 D(M)= XX(I,1,49)
      RETURN
   20 INCR = 1
      N1= 1
   30 L = 2
      K1=N1+INCR
      IF ( X .LT. XY(  1 ) )  GO TO 120
      IF ( X .NE. XY( N1) )   GO TO 40
      K = N1
      K1 = N1
      GO TO 140
   40 DO 110 KK=L,49
      KM1=K1-INCR
      IF(X-XY(K1))50,55 ,60
   50 IF ( X .GE. XY( KM1 ) )  GO TO 70
      GO TO 100
   60 IF ( X .LE. XY( KM1 ) )  GO TO 70
  100 K1=K1+INCR
  11* CONTINUE
      GO TO 120
   55 K=K1
      GO TO 140
   70 K=KM1
  140 N =NBX( K1 )
  141 L = K
      DO 190 JJ1=2,N
      IF(R-XX(1,JJ1,K1))150,169,160
  150 IF(R.GE.XX(1,JJ1-1,K1))GO TO 210
      GO TO 190
  160 IF(R.LE.XX(1,JJ1-1,K1))GO TO 210
  190 CONTINUE
      GO TO 120
  169 JJ=JJ1
      GO TO 220
  210 JJ=JJ1-1
  220 N = NBX( K )
      DO 280 J1=2,N
      IF(R-XX(1,J1,K)) 230,249,240
```

```
  230 IF(R.GE.XX(1,J1-1,K)) GOTO 305                                  INTERP    60
      GO TO 280                                                       INTERP    61
  240 IF(R.LE.XX(1,J1-1,K)) GOTO 305                                  INTERP    62
  280 CONTINUE                                                        INTERP    63
      GO TO 120                                                       INTERP    64
  249 J=J1                                                            INTERP    65
      GO TO 310                                                       INTERP    66
  305 J = J1- 1                                                       INTERP    67
  310 DO 330 M=1,4                                                    INTERP    68
      I = M + 1                                                       INTERP    69
      IF ( K .NE. K1 )    GO TO 329                                   INTERP    70
      IF ( J .NE. J1 )    GO TO 327                                   INTERP    71
      D( M ) = XX( I, J, K )                                          INTERP    72
      GO TO 330                                                       INTERP    73
  327 D( M ) = XX( I, J, K ) + ( R - XX( 1, J, K ) ) / ( XX( 1, J1, K )  INTERP    74
     1 - XX( 1, J, K ) ) * ( XX( I, J1, K ) - XX( I, J, K ) )          INTERP    75
      GO TO 330                                                       INTERP    76
  329 D( M ) =                    XX( I, J, K ) + ( XX( I, J1, K  ) -  INTERP    77
     3 XX( I, J, K) ) / ( XX( 1, J1, K ) - XX( 1, J, K ) )             INTERP    78
     4 * ( R - XX( 1, J, K ) )                                        INTERP    79
      D(M) = D ( M )      +(( XX( I, JJ, K1 ) + ( XX( I, JJ1, K1 ) -  INTERP    80
     1 XX( I, JJ, K1) ) / ( XX( 1, JJ1, K1 ) - XX( 1, JJ, K1 ) ) *    INTERP    81
     2 ( R - XX( 1, JJ, K1 ) ))- D( M ) )                             INTERP    82
     4                            / ( YY( K1 ) - YY( K ) )            INTERP    83
     5 * ( X - YY( K ) )                                              INTERP    84
  330 CONTINUE                                                        INTERP    85
      RETURN                                                          INTERP    86
      END                                                             INTERP    87
```

```
      SUBROUTINE PLUSIG
C
C  APPARENT SPECTRAL RADIANCES OF PLUMES
      REAL L,NU,NUFREQ,NOZ,NUINC
      REAL KH2O,KCO2
C
C
C
C  INSERT THE FOLLOWING CARD AND REMOVE APPROPRIATE CARD FOR
C  MULTIPLE WAVELENGTHS
C
C     DIMENSION XH2O(20),GAS(4),NU(5,300),ALPHA(2),
C    1 TAUV(50),TAUV1(50),TAUV4(50),DNU(5,300),
C
      DIMENSION XH2O(20),GAS(4),NU(300),ALPHA(2),
     1 TAUV(50),TAUV1(50),TAUV4(50),DNU(300),
     2 WEA(3),PA(50),PB(50),PA1(50),PB1(50),
     3 K(7),B(7),TMP(7),K1(7),B1(7),TMP1(7)
C
      COMMON/BETAK1/KH2O(7,439),BH2O(7,439)
      COMMON/BETAK/KCO2(7,176),BCO2(7,114)
      COMMON/CHUCK/NT,NE,NFREQ,NU,NUFRST,NUINC,DNU
C
C  REMOVE COMMENT CARDS FOR SPECTRAL DISTRIBUTION OF SIGNATURES
C  AT ALL RANGES AND ALL WAVELENGTHS
C
      COMMON/STAN/ALTOBS(5),ALTPLM,XRANGE(5),IATMO,TBACK(5),TBACKC
      COMMON/HALT/ITYPE,ITAU,IL,DA,ADB(5)
      COMMON/ATMO/NATMO,NRANG,ASPDEG
      COMMON/ORST/XTRA(20),NRG,XXTRA(15),AMI(5),AME(5),YTRA(2)
      COMMON/OHOLD/EXTRA(250)
      COMMON/EXTEMS/EAREA(20),ETEMP(20),NEXT,XCC,SEXT(5,1)
C
C  INSERT FOLLOWING CARDS FOR MULTIPLE WAVELENGTHS
C
C     COMMON/SIG/SGAS(5,5),SAMTL(5,5),SMTL(5,5),SBGR(5,5)
C     COMMON/SSIG/SPSIG(5,5,300)
C
      COMMON/SSIG/SPSIG(1,5,300)
      COMMON/SIG/SGAS(5,1),SAMTL(5,1),SMTL(5,1),SBGR(5,1)
      COMMON/SPATIAL/ISPAT
      COMMON/LOS/DS(50), T(50),P1(50),P2(50),P3(50)
      COMMON/FILTR/IFILTER,BFILTR(300)
      COMMON/FILSIG/FMP(5),FAMP(5),FGAS(5),FBG(5),FEXT(5)
      COMMON/GAS/IRADCK
      DATA WEA/3HDRY,4HNOR.,3HWET/
      DATA EXPO/-9./
      DATA ALPHA(1),ALPHA(2)/0.2,0.769/
      DATA GAS/3HH2O,3HCO2,2HN2,3HN2O/
C
C  ROUTINE TO COMPUTE APPARENT SPECTRAL RADIANCES OF THE PLUME
C  RAY.  LOGIC AND A MAJORITY OF DATA BASED ON THE UNIVERSITY
C  OF MICHIGAN PLUMES MODEL.
C  COMPUTES RADIANT INTENSITY IN WATTS/SR FOR THE [illegible]
C  EACH OF THE NRG WAVELENGTHS
C     SUMGS  GAS RADIANCE
C     SUMBG  BACKGROUND RADIANCE
```

```
C     SUMHP  ATTENUATED METALS                                          PLUSIGS   59
C     SNAHP  BLACK BODY RADIANCE                                        PLUSIGS   60
C   THIS ROUTINE INITIALIZES NU AND DNU FOR EACH WAVELENGTH             PLUSIGS   61
C                                                                       PLUSIGS   62
C                                                                       PLUSIGS   63
C   REMOVE THE FOLLOWING CARD FOR MULTIPLE WAVELENGTHS                  PLUSIGS   64
C                                                                       PLUSIGS   65
      NRG=1                                                             PLUSIGS   66
      IF(IRADCK.LE.0) GO TO 151                                         PLUSIGS   67
      NT=1                                                              PLUSIGS   68
         IF(EAREA(1).GT.0.0.AND.IRADCK.EQ.2) NT=0                       PLUSIGS   69
      IL=1                                                              PLUSIGS   70
  151 CONTINUE                                                          PLUSIGS   71
      BBC=IATMD                                                         PLUSIGS   72
C                                                                       PLUSIGS   73
      NHOLD=NT                                                          PLUSIGS   74
      DO 2000 IR=1,NRANG                                                PLUSIGS   75
      NT=NHOLD                                                          PLUSIGS   76
      RANGE=XRANGE(IR)                                                  PLUSIGS   77
   50 IF(RANGE.NE.0.)GO TO 55                                           PLUSIGS   78
      NA=0                                                              PLUSIGS   79
      GO TO 57                                                          PLUSIGS   80
   55 NA=NE                                                             PLUSIGS   81
      CALL ATMOS(IR)                                                    PLUSIGS   82
      XCAL=0.                                                           PLUSIGS   83
      DO 49 I=1,NA                                                      PLUSIGS   84
      XCAL=XCAL+(P1(I)+P2(I)+P3(I))*273.15*DS(I)*8.0080026/T(I)         PLUSIGS   85
   49 XN2O(I)=XCAL                                                      PLUSIGS   86
   57 CONTINUE                                                          PLUSIGS   87
      DO 2000 IK=1,NRG                                                  PLUSIGS   88
      IF(IL.LT.0) GO TO 332                                             PLUSIGS   89
      XXRAN=RANGE/1.0E+5                                                PLUSIGS   90
      ALT=ALTPLM/1.0E+5                                                 PLUSIGS   91
      ALO=ALTOBS(IR)/1.0E+5                                             PLUSIGS   92
      WRITE(6,3311) XXRAN,ASPDEG                                        PLUSIGS   93
      WRITE(6,333) NEA(NATMO)                                           PLUSIGS   94
      WRITE(6,334) ALT,ALO                                              PLUSIGS   95
      WRITE(6,330)                                                      PLUSIGS   96
  332 CONTINUE                                                          PLUSIGS   97
C                                                                       PLUSIGS   98
C   SETTUP NU AND DNU FOR WAVELENGTH OF CALCULATION (#IK)               PLUSIGS   99
C                                                                       PLUSIGS  100
      SUMEX=0.                                                          PLUSIGS  101
      SFP=0.                                                            PLUSIGS  102
      SFAP=0.                                                           PLUSIGS  103
      SFGS=0.                                                           PLUSIGS  104
      SFBG=0.                                                           PLUSIGS  105
      SFX=1.                                                            PLUSIGS  106
      SUMGS=0.                                                          PLUSIGS  107
      SUMBG=0.                                                          PLUSIGS  108
      SNAHP=0.                                                          PLUSIGS  109
      SUMHP=0.                                                          PLUSIGS  110
         IF(NUFRST.NE.0) GO TO 335                                      PLUSIGS  111
      WEND=1.0E+4/AMI(IK)                                               PLUSIGS  112
      WBEG=1.0E+4/AME(IK)                                               PLUSIGS  113
      XUC=WBEG                                                          PLUSIGS  114
      IF(NIJHG.GT.0.) GO TO 42                                          PLUSIGS  115
```

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      C                                                                  PLUSIG$ 116
      C  INCREMENTS BASED ON MAXIMUM RESOLUTION OF DATA INCLUDED IN      PLUSIG$ 117
      C  THE UNIVERSITY OF MICHIGAN PLUMES PROGRAM                       PLUSIG$ 118
      C                                                                  PLUSIG$ 119
            I=1                                                          PLUSIG$ 120
            DN=25.                                                       PLUSIG$ 121
            IF(XUC.LT.2000.) GO TO 602                                   PLUSIG$ 122
            IF(XUC.GT.2400..AND.XUC.LT.3000.) GO TO 602                  PLUSIG$ 123
            IF(XUC.GT.3770.) GO TO 602                                   PLUSIG$ 124
            DN=10.                                                       PLUSIG$ 125
  602       NWB=INT(2.*WBEG/DN)+1                                        PLUSIG$ 126
            XUC=FLOAT(NWB)*DN/2.                                         PLUSIG$ 127
      C                                                                  PLUSIG$ 128
      C     DNU(IK,1)=XUC-WBEG+DN/2.                                     PLUSIG$ 129
      C     NU(IK,1)=XUC                                                 PLUSIG$ 130
      C                                                                  PLUSIG$ 131
      C  DO THE SAME FOR ALL NU AND DNU CARDS IF MULTIPLE WAVELENGTHS TO  PLUSIG$ 132
      C  BE UTILIZED                                                     PLUSIG$ 133
      C                                                                  PLUSIG$ 134
            DNU(1)=XUC-WBEG+DN/2.                                        PLUSIG$ 135
            NU(1)=XUC                                                    PLUSIG$ 136
            DNA=DN                                                       PLUSIG$ 137
            GO TO 41                                                     PLUSIG$ 138
   40       I=I+1                                                        PLUSIG$ 139
            DNU(I)=DN                                                    PLUSIG$ 140
            NU(I)=XUC                                                    PLUSIG$ 141
   41       XUC=XUC+DNA/2.                                               PLUSIG$ 142
            DN=25.                                                       PLUSIG$ 143
            IF(XUC.LT.2000.) GO TO 601                                   PLUSIG$ 144
            IF(XUC.GT.2400..AND.XUC.LT.3000.) GO TO 601                  PLUSIG$ 145
            IF(XUC.GT.3770.) GO TO 601                                   PLUSIG$ 146
            DN=10.                                                       PLUSIG$ 147
  601       XUC=XUC+DN/2.                                                PLUSIG$ 148
            DNA=DN                                                       PLUSIG$ 149
            IF(XUC.LT.WEND) GO TO 40                                     PLUSIG$ 150
            NFREQ=I                                                      PLUSIG$ 151
            DNU(I)=WEND-NU(I-1)-0.5*DNU(I-1)                             PLUSIG$ 152
            GO TO 58                                                     PLUSIG$ 153
      C                                                                  PLUSIG$ 154
      C  INCREMENTS AND FREQUENCY CENTERS BASED ON NUINC (DEFAULT=50CM-1) PLUSIG$ 155
      C                                                                  PLUSIG$ 156
   42       NFREQ=INT((WEND-WBEG)/NUINC)+1                               PLUSIG$ 157
            XUC=XUC+NUINC/2.                                             PLUSIG$ 158
            DO 43 I=1,NFREQ                                              PLUSIG$ 159
            NU(I)=XUC                                                    PLUSIG$ 160
            DNU(I)=NUINC                                                 PLUSIG$ 161
   43       XUC=XUC+NUINC                                                PLUSIG$ 162
   44       DNU(NFREQ)=WEND-NU(NFREQ)+NUINC/2.                           PLUSIG$ 163
            IF(DNU(NFREQ).EQ.0.) NFREQ=NFREQ-1                           PLUSIG$ 164
   58       CONTINUE                                                     PLUSIG$ 165
            NUFRST=1                                                     PLUSIG$ 166
      C                                                                  PLUSIG$ 167
      C     NUFEB(IK)=NUFREQ                                             PLUSIG$ 168
      C                                                                  PLUSIG$ 169
  335       L=0.                                                         PLUSIG$ 170
               IF(NT.EQ.0) NT=NA                                         PLUSIG$ 171
            CALL SETTAU(NT,DS,T,P1,P3,ALPHA(1),PA1,PB1)                  PLUSIG$ 172
```

```
      CALL SETTAU(NT,DS,T,P2,P3,ALPHA(2),PA,PB)
      DO 200 II=1,NFREQ
      CALL KBCAL(NU(II),GAS(1),K1      ,B1      ,TMP1,NTP1)
      CALL KBCAL(NU(II),GAS(2),K       ,B       ,TMP,NTP)
      GNAME=GAS(1)
      NUFREQ=NU(II)
      CALL TAUCAL(K1       ,B1       ,TMP1-NTP1,NT,PA1,PB1,
     1T,ITYPE,EXPO,TAUV1)
  122 GNAME=GAS(2)
      CALL TAUCAL(K        ,B        ,TMP,NTP,NT,PA,PB,T,ITYPE,
     1EXPO,TAUV)
      GNAME=GAS(4)
      CALL TAUH2O(NUFREQ,NA,NT,XH2O,TAUV4)
      SUMG=0.
      IF(NA.EQ.NT) GO TO 141
      IF(NA.GT.0) GO TO 132
      SUMG=PLANCK(T(1),NUFREQ)*(1.-TAUV1(1)*TAUV(1)*TAUV4(1))
      IF(NT.LT.2) GO TO 150
  132 NTSS=NA+1
      IF(NA.EQ.0) NTSS=2
      DO 140 I=NTSS,NT
      TAUCHK=TAUV(I-1)*TAUV1(I-1)*TAUV4(I-1)-TAUV(I)*TAUV1(I)*TAUV4(I)
      IF(TAUCHK.LT.0.) TAUCHK=0.
      SUMG=SUMG+PLANCK(T(I),NUFREQ)*TAUCHK
  140 CONTINUE
  141 CONTINUE
      TAUVS=1.
      IF(RANGE.GT.0.) TAUVS=TAUV(NA)*TAUV1(NA)*TAUV4(NA)
  150 L=SUMG*DA*DNU(II)
      NOZ=TBACK(IK)*BBC
      SNHP=0.
      IF(IRADCK.GT.0) SNHP=1.-TAUV1(1)*TAUV(1)*TAUV4(1)
      FP=0.
      FAP=0.
      FG=0.
      FX=0.
      SHP=0.
      SBG=0.
      SEX=0.
      IF(KCC.EQ.0.) GO TO 214
      DO 215 KK=1,NEXT
      SEY=PLANCK(ETEMP(KK),NUF      )*DNU(II)*EAREA(KK)
  215 SEX=SEX+SEY*TAUVS
  214 CONTINUE
      IF(NOZ.LE.0.) GO TO 191
      SNHP=PLANCK(NOZ,NUFREQ)*DNU(II)*ABB(IK)*BBC
      SHP=SNHP*TAUV(NT)*TAUV1(NT)*TAUV4(NT)
  191 IF(TBACKC.LE.0.) GO TO 310
      SBG=PLANCK(TBACKC,NUFREQ)*DNU(II)*DA
  310 IF(L.LT.0) GO TO 210
      WRITE(6,300) NU(II),DNU(II),L,SNHP,SHP,SBG,DA,ABB(IK),TAUVS
  210 SUMHP=SUMHP+SHP
      SNAHP=SNAHP+SNHP
      SUMBG=SUMBG+SBG
      SUMGS=SUMGS+L
      SUMEX=SUMEX+SEX
C
```

```
      SPSIG(IK,IR,II)=L-SBG+SHP+SPSIG(IK,IR,II)                         PLUSIGS  230
      SPSIG(IK,IR,II)=SPSIG(IK,IR,II)+SEX                               PLUSIGS  231
      IF(IFILTER.EQ.0) GO TO 200                                        PLUSIGS  232
      FGS=L*BFILTR(II)                                                  PLUSIGS  233
      FX=SEX*BFILTR(II)                                                 PLUSIGS  234
      FP=SNHP*BFILTR(II)                                                PLUSIGS  235
      FAP=SHP*BFILTR(II)                                                PLUSIGS  236
      FG=SBG*BFILTR(II)                                                 PLUSIGS  237
      SFP=SFP+FP                                                        PLUSIGS  238
      SFAP=SFAP+FAP                                                     PLUSIGS  239
      SFGS=SFGS+FGS                                                     PLUSIGS  240
      SFBG=SFBG+FG                                                      PLUSIGS  241
      SFX=SFX+FX                                                        PLUSIGS  242
C                                                                       PLUSIGS  243
  200 CONTINUE                                                          PLUSIGS  244
      ZZZ=SUMHP-SUMBG+SUMGS                                             PLUSIGS  245
      IF(ISPAT.GT.0) WRITE (8) ZZZ                                      PLUSIGS  246
      IF(IL.LT.0) GO TO 211                                             PLUSIGS  247
      WRITE(6,212) ZZZ,SUMHP,SNAHP,SUMGS,SUMBG                          PLUSIGS  248
      IF(XCC.NE.0.) WRITE(6,216) SUMEX                                  PLUSIGS  249
  211 CONTINUE                                                          PLUSIGS  250
C                                                                       PLUSIGS  251
C  IR,IK IMPLIES RANGE AND WAVELENGTH                                   PLUSIGS  252
C  INTEGRATING OVER THE ENTIRE PLUME                                    PLUSIGS  253
C                                                                       PLUSIGS  254
      SGAS(IR,IK)=SGAS(IR,IK)+SUMGS                                     PLUSIGS  255
      SAMTL(IR,IK)=SAMTL(IR,IK)+SUMHP                                   PLUSIGS  256
      SMTL(IR,IK)=SMTL(IR,IK)+SNAHP                                     PLUSIGS  257
      SBGR(IR,IK)=SBGR(IR,IK)+SUMBG                                     PLUSIGS  258
      SEXT(IR,IK)=SEXT(IR,IK)+SUMEX                                     PLUSIGS  259
      IF(IFILTER.EQ.0) GO TO 401                                        PLUSIGS  260
      ZZZ=SFGS-SFBG+SFAP                                                PLUSIGS  261
      IF(ISPAT.GT.0) WRITE (8) ZZZ                                      PLUSIGS  262
      FHP(IR)=FHP(IR)+SFP                                               PLUSIGS  263
      FAHP(IR)=FAHP(IR)+SFAP                                            PLUSIGS  264
      FGAS(IR)=FGAS(IR)+SFGS                                            PLUSIGS  265
      FBG(IR)=FBG(IR)+SFBG                                              PLUSIGS  266
      FEXT(IR)=FEXT(IR)+SFX                                             PLUSIGS  267
  401 CONTINUE                                                          PLUSIGS  268
      IF(IK.NE.NRG) GO TO 2000                                          PLUSIGS  269
      IF(IR.EQ.NRANG) GO TO 2000                                        PLUSIGS  270
      IF(RANGE.EQ.0.) GO TO 2000                                        PLUSIGS  271
      NT=NHOLD                                                          PLUSIGS  272
      DO 400 I=1,NT                                                     PLUSIGS  273
      P1(I)=P1(I+NA)                                                    PLUSIGS  274
      P2(I)=P2(I+NA)                                                    PLUSIGS  275
      P3(I)=P3(I+NA)                                                    PLUSIGS  276
      DS(I)=DS(I+NA)                                                    PLUSIGS  277
  400 T(I)=T(I+NA)                                                      PLUSIGS  278
 2000 CONTINUE                                                          PLUSIGS  279
  300 FORMAT(5X,F10.2,2X,F10.3,6(2X,E10.4),2X,F10.5)                    PLUSIGS  280
  330 FORMAT(1H0,8X,*NU*,7X,*DELTA NU*,6X,*RAY COMPONENT RADIANT INTENSI PLUSIGS  281
     1TY WATTS/SR*,9X,*DA*,4X,*HOT PARTS*,5X,*ATMO*/8X,*CM-1*,8X,*CM-1*, PLUSIGS  282
     28X,*GAS*,6X,*METALS*,4X,*ATTN METAL*,2X,*BACKGROUND*,5X,*SQ CM*,7X PLUSIGS  283
     3,*SQ CM*,6X,*TRANS*)                                              PLUSIGS  284
  331 FORMAT(1H0,3H***,*RAY DATA FOR A RANGE OF *,F10.3,* KM AND AN ASPE PLUSIGS  285
     1CT ANGLE OF *,F5.1,* DEGREES*,3H***)                              PLUSIGS  286
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290          333   FORMAT(2X,2H**,*ATMOSPHERIC TYPE = *,A4,2H**)                    PLUSIGS    287
             212   FORMAT(1H0,3X,*RAY TOTALS\ APPARENT RADIANCE = *,F10.5/16X,*ATTENU PLUSIGS    288
                  1ATED METAL = *,F10.5/16X,*METALS = *,F10.5/16X,*GAS = *,F10.5/16X, PLUSIGS    289
                  2*BACKGROUND = *,F10.5)                                             PLUSIGS    290
             334   FORMAT(2X,1H*,*VEHICLE ALTITUDE = *,F6.2,* KM AND OBSERVER ALTITUD PLUSIGS    291
                  1E = *,F6.2,* KM*)                                                  PLUSIGS    292
             216   FORMAT(15X,*EXTERNAL EMISSIONS = *,F10.5)                          PLUSIGS    293
                   END                                                                PLUSIGS    294
```

```
      SUBROUTINE ATMOS(IR)                                              ATMOS    2
      DIMENSION NU(300),XA(50),XB(50),XC(50),XD(50),XE(50),DNU(300)     ATMOS    3
C                                                                       ATMOS    4
      DIMENSION A(3,3),B(3,3)                                           ATMOS    5
C                                                                       ATMOS    6
      COMMON/DHOLD/XA,XB,XC,XD,XE                                       ATMOS    7
      COMMON/STAN/ALTOB(5) ,ALTPLM,XRANGE(5),IATMO,TBACK(5),TBACKC       ATMOS    8
      COMMON/ATMO/NATMO,NRANG,ASPDEG                                    ATMOS    9
      COMMON/CHUCK/NT,NA,NFREQ,NU,NUFRST,NUINC,DNU                      ATMOS   10
      COMMON/LOS/DS(50),T(50),P1(50),P2(50),P3(50)                      ATMOS   11
      DATA A/-7.515,6.988,22.83,-7.602,6.968,                           ATMOS   12
     128.49,-5.745,6.938,37.26/,                                        ATMOS   13
     2B/-.01446,-.00423,-.2221,-.01295,-.004106,                        ATMOS   14
     3-.219,-.01337,-.00413,-.2151/                                     ATMOS   15
      DATA RE/6.44E8/                                                   ATMOS   16
      RANGE=XRANGE(IR)                                                  ATMOS   17
      ALTOBS=ALTOB(IR)                                                  ATMOS   18
         IF(NT.EQ.0) GO TO 100                                          ATMOS   19
      DO 101 I=1,NT                                                     ATMOS   20
      XA(I)=DS(I)                                                       ATMOS   21
      XB(I)=T(I)                                                        ATMOS   22
      XC(I)=P1(I)                                                       ATMOS   23
      XD(I)=P2(I)                                                       ATMOS   24
  101 XE(I)=P3(I)                                                       ATMOS   25
C                                                                       ATMOS   26
  100 DALT=ALTPLM-ALTOBS                                                ATMOS   27
      AO2=ALTOBS*ALTOBS                                                 ATMOS   28
      RT2=RANGE*RANGE                                                   ATMOS   29
      AP2=ALTPLM*ALTPLM                                                 ATMOS   30
      DINC=RANGE/FLOAT(NA)                                              ATMOS   31
      DO 150 I=1,NA                                                     ATMOS   32
      DS(I)=DINC                                                        ATMOS   33
      R=DINC*FLOAT(I-1)+DINC/2.                                         ATMOS   34
      X=(AO2+2*ALTOBS*RE+R*R-(R/RANGE)*(AO2-2*RE*DALT+                  ATMOS   35
     1RT2-AP2))/(ALTOBS+2*RE)                                           ATMOS   36
      X=X/3.04E3                                                        ATMOS   37
      T(I)=273.15+A(3,NATMO)+B(3,NATMO)*X                               ATMOS   38
      PTOT=EXP(A(2,NATMO)+B(2,NATMO)*X)*1.E-3                           ATMOS   39
      P1(I)=PTOT*13.01*EXP(A(1,NATMO)+B(1,NATMO)*X)                     ATMOS   40
      P2(I)=PTOT*.00032                                                 ATMOS   41
      P3(I)=PTOT-P1(I)-P2(I)                                            ATMOS   42
  150 CONTINUE                                                          ATMOS   43
         IF(NT.EQ.0) GO TO 200                                          ATMOS   44
      DO 102 I=1,NT                                                     ATMOS   45
      NH=NA+I                                                           ATMOS   46
      DS(NH)=XA(I)                                                      ATMOS   47
      T(NH)=XB(I)                                                       ATMOS   48
      P1(NH)=XC(I)                                                      ATMOS   49
      P2(NH)=XD(I)                                                      ATMOS   50
  102 P3(NH)=XE(I)                                                      ATMOS   51
      NT=NT+NA                                                          ATMOS   52
  200 CONTINUE                                                          ATMOS   53
      RETURN                                                            ATMOS   54
      END                                                               ATMOS   55
C ROUTINE TO COMPUTE PATH PARAMETERS                                    SETTAU   2
C                                                                       SETTAU   3
```

```
      SUBROUTINE SETTAU(NDIV,DL,TMP,PABSOR,PBROAD,ALPHA,PA,PB)          SETTAU   4
      DIMENSION PA(50),PB(50),DL(50),TMP(50),PABSOR(50),PBROAD(50)      SETTAU   5
      DO 100 I=1,NDIV                                                   SETTAU   6
      PA(I)=273.15*DL(I)*PABSOR(I)/TMP(I)                               SETTAU   7
      PB(I)=PABSOR(I)+ALPHA*PBROAD(I)                                   SETTAU   8
  100 CONTINUE                                                          SETTAU   9
      RETURN                                                            SETTAU  10
      END                                                               SETTAU  11
```

```
      SUBROUTINE TAUCAL(K,B,TEMP,NTEMP,NDIV,PA,PB,TMP,ITYPE,EXPO,TAU)
C
C  TRANSMITTANCE CALCULATION
C
      DIMENSION PA(50),PB(50),TAU(50),TEMP(10),TMP(50),AI(7),
     1 BI(7),DI(7),K(7),B(7),BR(7),CI(7),PK(50),F(50)
      REAL INTERPO,K
      COMMON/DHOLD/PK,F,EXTRA(150)
      DATA BR/0.,2.,5.,10.,20.,50.,100./
      DATA AI/-.675,-.37,.6,3.19,9.1,29.1,105.3/
      DATA BI/-.349,.62,3.15,9.25,22.8,67.1,289.2/
      DATA CI/.535,.712,.892,1.15,1.63,2.78,4.045/
      DATA DI/.07,.428,.788,1.3,2.26,4.56,7.09/
C
C COMPUTE BE & ELEMENTS OF SUMS
88    SUMN=0.
      SUMD=0.
      DO 82 I=1,NDIV
      IF(TMP(I).GT.300.)GO TO 81
      PK(I)=K(1)*PA(I)
      F(I)=PK(I)*B(1)*PB(I)
      GO TO 83
81    IF(TMP(I).LT.3000.)GO TO 84
      PK(I)=K(NTEMP)*PA(I)
      F(I)=PK(I)*B(NTEMP)*PB(I)
      GO TO 83
84    PK(I)=INTERPO(TEMP,K,NTEMP,TMP(I))*PA(I)
      F(I)=PK(I)*INTERPO(TEMP,B,NTEMP,TMP(I))*PB(I)
83    SUMD=SUMD+PK(I)
      SUMN=SUMN+F(I)
82    CONTINUE
      IF(SUMD.LE.0.)GO TO 700
      BETEFF=SUMN/SUMD
C  BEGINNING OF TAU CALC. LOOP
      X=0.
      DO 600 I=1,NDIV
C  COMPUTE B/BE & DETERMINE WHERE WE ARE IN ETA FAMILY
      IF((PK(I).LE.0.).OR.(BETEFF.LE.0.))GO TO 240
      BBE=F(I)/(BETEFF*PK(I))
      DX=PK(I)/BETEFF
      IF(DX.LE.0.)GO TO 240
      IF((EXPO.LE.1.1).AND.(EXPO.GE.0.))GO TO 120
      ARG=X+((DX*(BBE+1.))/2.)
      IF(ARG.LE.0.1)GO TO 100
      IF((BBE.LE.1.).AND.(ARG.GE.10.))GO TO 110
      IF((BBE.LE.1.05).AND.(BBE.GE..95))GO TO 100
      GO TO 200
C
C COMPUTATION OF X FOR LIMITING ETA VALUES
100   X=X+DX
      GO TO 240
110   X=X+DX*BBE
      GO TO 240
120   X=X+DX*(BBE**EXPO)
      GO TO 240
C
C CALCULATION OF ETA
```

```
      200 XI5=1.+0.185*BBE                                            TAUCAL   59
          DO 210 J=1,7                                                TAUCAL   60
          IF(BBE.LE.BR(J))GO TO 220                                   TAUCAL   61
      210 CONTINUE                                                    TAUCAL   62
          J=6                                                         TAUCAL   63
          RESID=0.                                                    TAUCAL   64
          GO TO 221                                                   TAUCAL   65
      220 RESID=(BBE-BR(J-1))/(BR(J)-BR(J-1))                         TAUCAL   66
      221 IF(ARG.GE.XI5)GO TO 230                                     TAUCAL   67
          C=CI(J-1)*(1.-RESID)+CI(J)*RESID                            TAUCAL   68
          D=DI(J-1)*(1.-RESID)+CI(J)*RESID                            TAUCAL   69
          ETA=C*ARG/(XI5+D*ARG)                                       TAUCAL   70
          X=X+DX*(BBE**ETA)                                           TAUCAL   71
          GO TO 240                                                   TAUCAL   72
      230 A=AI(J-1)*(1.-RESID)+AI(J)*RESID                            TAUCAL   73
          BX=BI(J-1)*(1.-RESID)+BI(J)*RESID                           TAUCAL   74
          ETA=(ARG+A)/(ARG+BX)                                        TAUCAL   75
          X=X+DX*(BBE**ETA)                                           TAUCAL   76
C CALCULATION OF TAU                                                   TAUCAL   77
      240 IF(X.GT.0.)GO TO 242                                        TAUCAL   78
          TAU(I)=1.                                                   TAUCAL   79
          GO TO 600                                                   TAUCAL   80
      242 BFACT=-BETEFF*X/(SQRT(1.+1.57879*X))                        TAUCAL   81
          GO TO (300,400),ITYPE                                       TAUCAL   82
      300 TAU(I)=EXP(BFACT)                                           TAUCAL   83
          GO TO 600                                                   TAUCAL   84
      400 TAU(I)=1.+BFACT                                             TAUCAL   85
      600 CONTINUE                                                    TAUCAL   86
          RETURN                                                      TAUCAL   87
C FOR UNUSUAL VALUES OF ARGUMENTS TAU IS SET TO 1.                      TAUCAL   88
      700 DO 710 I=1,NDIV                                             TAUCAL   89
          TAU(I)=1.                                                   TAUCAL   90
      710 CONTINUE                                                    TAUCAL   91
          RETURN                                                      TAUCAL   92
          END                                                         TAUCAL   93
```

```
      SUBROUTINE KBCAL(NUFREQ,GAS,K,B,TEMP,NTEMP)
      COMMON/BETAK/KCO2(7,176),BCO2(7,144)
      COMMON/BETAK1/KH2O(7,439),BH2O(7,439)
      DIMENSION HILIM(4),LOLIM(4),TH2O(7),TCO2(7),NT(4),K(10),B(10)
     1,ID(4),TEMP(10)
      REAL LOLIM,NUFREQ,      K,KH2O,KCO2
      REAL ID
      DATA ID/3HH2O,3HCO2,2HHF,2HCO/
      DATA HILIM/11000.,3770./,LOLIM/50.,1980./
      DATA TH2O/300.,600.,1000.,1500.,2000.,2500.,3000./,NT/7,7/
      DATA TCO2/300.,600.,1200.,1500.,1800.,2400.,3000./
C SET GAS INDEX & CHECK IF NUFREQ IS WITHIN LIMITS OF B, M, PARAMETERS
      DO 10 I=1,4
      IF(GAS.EQ.ID(I))GO TO 20
   10 CONTINUE
      GO TO 17
   12 NTEMP=NT(I)
      GO TO (13,15,17,17),I
   13 DO 14 J=1,NTEMP
      TEMP(J)=TH2O(J)
      K(J)=0.
   14 B(J)=1.
      GO TO 19
   15 DO 16 J=1,NTEMP
      TEMP(J)=TCO2(J)
      K(J)=0.
   16 B(J)=1.
      GO TO 19
   17 NTEMP=2
      DO 18 J=1,2
      K(J)=0.
   18 B(J)=1.
      TEMP(1)=300.
      TEMP(2)=3000.
   19 RETURN
   20 IF((NUFREQ.GT.HILIM(I)).OR.(NUFREQ.LT.LOLIM(I)))GO TO 12
C
C SET K,B ARRAYS FOR APPROPRIATE NUFREQ & GAS
      GO TO (30,40,60,70),I
   30 FINDEX=((NUFREQ-50.)/25.)+1.
      INDEX=FINDEX
      FRACT=FINDEX-FLOAT(INDEX)
      FRAM1=1.-FRACT
      NTEMP=NT(I)
      DO 32 J=1,NTEMP
      TEMP(J)=TH2O(J)
      K(J)=KH2O(J,INDEX)*FRAM1+KH2O(J,INDEX+1)*FRACT
      B(J)=BH2O(J,INDEX)*FRAM1+BH2O(J,INDEX+1)*FRACT
   32 CONTINUE
      GO TO 80
C
   40 IF(NUFREQ.LT.3080.)GO TO 41
      FINDEX=45.+((NUFREQ-3080.)/10.)
      GO TO 45
   41 IF(NUFREQ.LT.3000.)GO TO 42
      FINDEX=44.+((NUFREQ-3000.)/80.)
      GO TO 45
```

```
   42 IF(NUFREQ.LT.2400.)GO TO 43                                   KBCAL  59
      FINDEX=43.+((NUFREQ-2400)/600.)                               KBCAL  60
      GO TO 48                                                      KBCAL  61
   43 IF(NUFREQ.LT.2000.)GO TO 44                                   KBCAL  62
      FINDEX=3+((NUFREQ-2000.)/10.)                                 KBCAL  63
      GO TO 48                                                      KBCAL  64
   44 FINDEX=1.+((NUFREQ-1900.)/50.)                                KBCAL  65
   48 INDEX=FINDEX                                                  KBCAL  66
      FRACT=FINDEX-FLOAT(INDEX)                                     KBCAL  67
      FRAM1=1.-FRACT                                                KBCAL  68
      NTEMP=NT(I)                                                   KBCAL  69
      DO 49 J=1,NTEMP                                               KBCAL  70
      B(J)=BCO2(J,INDEX)*FRAM1+BCO2(J,INDEX+1)*FRACT                KBCAL  71
      TEMP(J)=TCO2(J)                                               KBCAL  72
   49 CONTINUE                                                      KBCAL  73
      IF(NUFREQ.LT.3560.)GO TO 51                                   KBCAL  74
      FINDEX=134.+((NUFREQ-3560.)/5.)                               KBCAL  75
      GO TO 58                                                      KBCAL  76
   51 IF(NUFREQ.LT.2990.)GO TO 52                                   KBCAL  77
      FINDEX=77.+((NUFREQ-2990.)/10.)                               KBCAL  78
      GO TO 58                                                      KBCAL  79
   52 IF(NUFREQ.LT.2400.)GO TO 53                                   KBCAL  80
      FINDEX=76.+((NUFREQ-2400.)/590.)                              KBCAL  81
      GO TO 58                                                      KBCAL  82
   53 IF(NUFREQ.LT.2150.)GO TO 54                                   KBCAL  83
      FINDEX=26.+((NUFREQ-2150.)/5.)                                KBCAL  84
      GO TO 58                                                      KBCAL  85
   54 FINDEX=1.+((NUFREQ-1900.)/10.)                                KBCAL  86
   58 INDEX=FINDEX                                                  KBCAL  87
      FRACT=FINDEX-FLOAT(INDEX)                                     KBCAL  88
      FRAM1=1.-FRACT                                                KBCAL  89
      DO 59 J=1,NTEMP                                               KBCAL  90
      K(J)=KCO2(J,INDEX)*FRAM1+KCO2(J,INDEX+1)*FRACT                KBCAL  91
   59 CONTINUE                                                      KBCAL  92
      GO TO 80                                                      KBCAL  93
C                                                                   KBCAL  94
   60 GO TO 12                                                      KBCAL  95
C                                                                   KBCAL  96
   70 GO TO 12                                                      KBCAL  97
C                                                                   KBCAL  98
   80 RETURN                                                        KBCAL  99
      END                                                           KBCAL 100
```

```
      FUNCTION PLANCK(T,W)                                              PLANCK   2
      DATA C1,C2/1.1909E-12,1.4388/                                     PLANCK   3
      IF(T.LE.0.)GO TO 5                                                PLANCK   4
      X=C2*W/T                                                          PLANCK   5
      IF(X.LT.172.)GO TO 10                                             PLANCK   6
    5 PLANCK=0.                                                         PLANCK   7
      RETURN                                                            PLANCK   8
   10 PLANCK=(C1*W*W*W)/(EXP(X)-1.)                                     PLANCK   9
      RETURN                                                            PLANCK  10
      END                                                               PLANCK  11
```

```
      REAL FUNCTION INTERPO(X,Y,N,ARG)                                  INTERPO   2
      DIMENSION X(5),Y(5)                                               INTERPO   3
      IF(X(1).LT.X(N)) GO TO 9                                          INTERPO   4
      IF(ARG.LT.X(N)) GO TO 15                                          INTERPO   5
      IF(ARG.GT.X(1)) GO TO 14                                          INTERPO   6
      DO 1 I=1,N                                                        INTERPO   7
      IF(ARG-X(I)) 1,20,30                                              INTERPO   8
    1 CONTINUE                                                          INTERPO   9
      GO TO 15                                                          INTERPO  10
    9 IF(ARG.LT.X(1)) GO TO 15                                          INTERPO  11
      DO 10 I=1,N                                                       INTERPO  12
      IF(X(I)-ARG) 10,20,30                                             INTERPO  13
   10 CONTINUE                                                          INTERPO  14
   14 INTERPO=ARG                                                       INTERPO  15
      RETURN                                                            INTERPO  16
   15 INTERPO=-ARG                                                      INTERPO  17
      RETURN                                                            INTERPO  18
   20 INTERPO=Y(I)                                                      INTERPO  19
      RETURN                                                            INTERPO  20
   30 INTERPO=Y(I-1)+(Y(I)-Y(I-1))*(ARG-X(I-1))                         INTERPO  21
     1 / (X(I)-X(I-1))                                                  INTERPO  22
      RETURN                                                            INTERPO  23
      END                                                               INTERPO  24
```

```
      SUBROUTINE TAUN2O(FREQ,NA,NT,XN2O,TAU)                          TAUN2O   2
C     SUBROUTINE TO COMPUTE TRANSMITTANCE DUE TO N2O IN PLUMES        TAUN2O   3
      DIMENSION XN2O(20),TAU(50),FN2O(23),SN2O(23)                     TAUN2O   4
      REAL INTERPO                                                     TAUN2O   5
      DATA FN2O/2114.,2128.,2146.,2174.,2186.,2208.,2220.,             TAUN2O   6
     12230.,2240.,2245.,2250.,2255.,2260.,2265.,2270.,                 TAUN2O   7
     22275.,2280.,2300.,2340.,2350.,2355.,2360.,2365./                 TAUN2O   8
      DATA SN2O/1.5E-4,9.29E-4,1.05E-2,.415,1.6,4.8,5.4,               TAUN2O   9
     15.,2.7,1.,.35,.15,.054,.021,7.2E-3,3.E-3,2.3E-3,1.7E-3,          TAUN2O  10
     21.72E-3,1.4E-3,9.4E-4,5.E-4,1.E-4/,NFSN2O/23/                    TAUN2O  11
      IF (NA.EQ.0) GO TO 200                                           TAUN2O  12
      IF (FREQ.GT.2365.) GO TO 200                                     TAUN2O  13
      IF (FREQ.LT.2114.) GO TO 200                                     TAUN2O  14
      CON=INTERPO(FN2O,SN2O,NFSN2O,FREQ)                               TAUN2O  15
      DO 100 I=1,NA                                                    TAUN2O  16
  100 TAU(I)=1.-ERF(SQRT(CON*XN2O(I)))                                 TAUN2O  17
         IF(NA.EQ.NT) GO TO 210                                        TAUN2O  18
      NB=NA+1                                                          TAUN2O  19
      DO 150 I=NB,NT                                                   TAUN2O  20
  150 TAU(I)=TAU(NA)                                                   TAUN2O  21
  210 CONTINUE                                                         TAUN2O  22
      RETURN                                                           TAUN2O  23
C     FREQ OUT OF RANGE OR NO ATMOSPHERE                               TAUN2O  24
  200 DO 250 I=1,NT                                                    TAUN2O  25
  250 TAU(I)=1.0                                                       TAUN2O  26
      RETURN                                                           TAUN2O  27
      END                                                              TAUN2O  28
```

```
      FUNCTION ERF(X)
      ERF=1.0                                                          ERF     2
      IF(X.GT.3.95)    RETURN                                          ERF     3
      FACN =-1.                                                        ERF     4
      SUM=X*(3.-X**2)/3.                                               ERF     5
      NMAX=4.6+X*(11.55+(2.8*X))                                       ERF     6
      DO 100 N=2,NMAX                                                  ERF     7
      FACN=-FACN*N                                                     ERF     8
      NN=2*N+1                                                         ERF     9
  100 SUM = SUM + X**NN/(FACN*NN)                                      ERF    10
      ERF=1.12837916709471*SUM                                         ERF    11
      RETURN                                                           ERF    12
      END                                                              ERF    13
                                                                       ERF    14
```

```
      OVEPLAY(XRHP,3,0)                                                 DATINT$   2
      PROGRAM DATINT                                                    DATINT$   3
      REAL NUINC,NU                                                     DATINT$   4
*     RAY                                                               DATINT$   5
      COMMON/RAY/                                                       DATINT$   6
     1 ADS,  ATST,  AOA,  DD,  DS,  L1                                  DATINT$   7
*     GEO                                                               DATINT$   8
      COMMON /GEO/                                                      DATINT$   9
     1   AE,      AL,      EB,      DOS,      NEN,     NP,              DATINT$  10
     2   RE,      RBD,     RBZ,     REN(10),  RF,      RO,              DATINT$  11
     3   ROZ,     RP,      RPZ,     SC,       SS,      TANA,            DATINT$  12
     4   TNB,     TANP,    XC,      XEN(10),  XF,      XO,              DATINT$  13
     5   XP,      RENO                                                  DATINT$  14
*     INP                                                               DATINT$  15
      COMMON /INP/                                                      DATINT$  16
     1 D,  DDZ,  DX,  DTST,  DZ,  NDZ,  NOP,  RAYPNT,  ZTST             DATINT$  17
*     OBST                                                              DATINT$  18
      COMMON /OBST/ HL(10), HU(10),                                     DATINT$  19
     1  NRG,      TA3(5),   TA4(5),   TGB(5),    AMI(5), AME(5)         DATINT$  20
     2, NO,       KO                                                    DATINT$  21
      DIMENSION NU(300),DNU(300)                                        DATINT$  22
      COMMON/CHUCK/N7,NY,NFREQ,NU,NUFRST,NUINC,DNU                      DATINT$  23
      COMMON/STAN/ALTOBS(5),ALTPLM,XRANGE(5),IATMO,TBACK(5),TBACKC      DATINT$  24
      COMMON/WALT/ITYPE,ITAU,IL,DA,ABB(5)                               DATINT$  25
      COMMON/SPATIAL/ISPAT                                              DATINT$  26
      COMMON/ATMO/NATMO,NRANG,ASPDEG                                    DATINT$  27
      COMMON/PLM/PLMGD(76+4),NOFLOW,PA,PB,DPOX,KDATA                    DATINT$  28
      COMMON/EXTEMS/EAREA(20),ETEMP(20),NEXT,XCC,SEXT(5,1)             DATINT$  29
      COMMON/FILTR/IFILTER,BFILTR(300)                                  DATINT$  30
      COMMON/GAS/IRADCK                                                 DATINT$  31
      IRADCK=0                                                          DATINT$  32
      NEXT=0                                                            DATINT$  33
      ISPAT=0                                                           DATINT$  34
      PA=PB=0.0                                                         DATINT$  35
      DO 200 IZ=1,7644                                                  DATINT$  36
  200 PLMGD(IZ)=0.                                                      DATINT$  37
      DPOX=0.                                                           DATINT$  38
      L1=N7=NY=NFREQ=NUFRST=0                                           DATINT$  39
      NUINC=50.                                                         DATINT$  40
      ALTPLM=TBACKC=0.                                                  DATINT$  41
      DO 1 I=1,5                                                        DATINT$  42
      XRANGE(I)=0.                                                      DATINT$  43
      ALTOBS(I)=0.                                                      DATINT$  44
      TBACK(I)=0.                                                       DATINT$  45
    1 ABB(I)=0.                                                         DATINT$  46
      RAYPNT=0.                                                         DATINT$  47
      IATMO=IL=-1                                                       DATINT$  48
      IFILTER=0                                                         DATINT$  49
      ITAU=-1                                                           DATINT$  50
      ITYPE=NATMO=NRANG=1                                               DATINT$  51
      AOA=DA=1.                                                         DATINT$  52
      NATMO=2                                                           DATINT$  53
      RB=0.                                                             DATINT$  54
      ASPDEG=90.                                                        DATINT$  55
      ATST=0.001                                                        DATINT$  56
      DDS=ADS=10.                                                       DATINT$  57
      DD=DS=0.                                                          DATINT$  58
```

```
      NP=NO=NOFLOW=0                                                    DATINTS   59
      REN(1)=.6                                                         DATINTS   60
      REN(2)=.5                                                         DATINTS   61
      REN(3)=REN(2)                                                     DATINTS   62
      XEN(1)=-1.                                                        DATINTS   63
      XEN(2)=0.                                                         DATINTS   64
      NRG=KDATA=1                                                       DATINTS   65
      XP=PP=0.                                                          DATINTS   66
      DX=RF=XF=0.                                                       DATINTS   67
      NDZ=4                                                             DATINTS   68
      AL=1000.                                                          DATINTS   69
      XCA=0.00233                                                       DATINTS   70
      ZTST=900.                                                         DATINTS   71
      NEN=2                                                             DATINTS   72
      NDZ=3                                                             DATINTS   73
      NOP=5                                                             DATINTS   74
      AMI(1)=2.0                                                        DATINTS   75
      AME(1)=2.1                                                        DATINTS   76
      NY=5                                                              DATINTS   77
      END                                                               DATINTS   78
```

```
      OVERLAY(XRHP,4,0)                                                 PLMDEF$   2
      PROGRAM PLMDEF                                                    PLMDEF$   3
C   PLUME DEFINITION    *    *                                          PLMDEF$   4
* FFL                                                                   PLMDEF$   5
      COMMON/FFL/RZ,NQ,NBSO,CP(4),RX,P,NS,FZ,                           PLMDEF$   6
     1   PPA,RGB,A1,DR,DX,NRO,K,TMW,XCO2NE,                             PLMDEF$   7
     2GMB,PR(5),DPS,AM2,KERR,DRO,X(5,100),Y(5,100),MR,CNST              PLMDEF$   8
*   PLM    *                                                            PLMDEF$   9
      COMMON/PLM/PLMGO(43),RCN,ST(50),NRD(50),PLM(5,30,50),NFLW,PA,PB,  PLMDEF$  10
     1   DPDX,KDATA,ISHK,JSHK,TANE,EQR                                  PLMDEF$  11
      DIMENSION XX(5,3,,50)                                             PLMDEF$  12
      EQUIVALENCE (XX(1,1,1),PLM(1,1,1))                                PLMDEF$  13
*  FL                                                                   PLMDEF$  14
      COMMON/FL/UA,TA,XCO2A,XH2OA,BX(50)                                PLMDEF$  15
*  GEO                                                                  PLMDEF$  16
      COMMON /GEO/                                                      PLMDEF$  17
     1   AB,       AL,       BB,       DDS,      NEN,      NP,          PLMDEF$  18
     2   RB,       PBO,      RBZ,       REN(10), RF,       RO,          PLMDEF$  19
     3   ROZ,      RP,       RPZ,      SC,       SS,       TANA,        PLMDEF$  20
     4   TNB,      TANP,     XC,       XEN(10),  XF,       XO,          PLMDEF$  21
     5   XP,       RENO                                                 PLMDEF$  22
      DATA NSL/0./                                                      PLMDEF$  23
      DATA CZMIN/.01/                                                   PLMDEF$  24
      DATA CZMAX/.05/                                                   PLMDEF$  25
C                                                                       PLMDEF$  26
      KERR=0                                                            PLMDEF$  27
      CZMIN=.05                                                         PLMDEF$  28
      CZMAX=.11                                                         PLMDEF$  29
      IP=5                                                              PLMDEF$  30
      ABX=1.                                                            PLMDEF$  31
      NO=0                                                              PLMDEF$  32
      NB=0                                                              PLMDEF$  33
      CNST=10.                                                          PLMDEF$  34
      AXX=0.                                                            PLMDEF$  35
      CALL OVERLAY(4HXRHP,4,1)                                          PLMDEF$  36
C     CALL PLUME                                                        PLMDEF$  37
       IF(RB.NE.0.) GO TO 11                                            PLMDEF$  38
      WRITE(6,4000)                                                     PLMDEF$  39
 4000 FORMAT(//2X,27H***EXHAUST RADIUS NOT GIVEN//)                     PLMDEF$  40
      GO TO 401                                                         PLMDEF$  41
   11 CONTINUE                                                          PLMDEF$  42
      XMIX=0.                                                           PLMDEF$  43
      QDX = 1.                                                          PLMDEF$  44
       DXPO=.5*(RB-RZ)                                                  PLMDEF$  45
      NSO=NS*10+1                                                       PLMDEF$  46
      NRX=NSO+2                                                         PLMDEF$  47
      PCODE=FLOAT(MR)/FLOAT(NSO-1)                                      PLMDEF$  48
         IF(PZ.LT.2200.*PA) PCODE=1.                                    PLMDEF$  49
      JNW=1+(NSO-1)*PCODE                                               PLMDEF$  50
      XX(1,1,50)=AM2                                                    PLMDEF$  51
      XX(2,1,50)=X(1,NRX)/SQRT(2403.*X(2,NRX))                          PLMDEF$  52
      PZ=P                                                              PLMDEF$  53
      NSK=5                                                             PLMDEF$  54
      CZAV=(CZMIN+CZMAX)/2.                                             PLMDEF$  55
      CZR=(CZMAX-CZMIN)/2.                                              PLMDEF$  56
      DX = DXPO/5.                                                      PLMDEF$  57
      IG = 0                                                            PLMDEF$  58
```

```
      XO=0.                                                             PLMDEFS  59
      K=1                                                               PLMDEFS  60
      CCJNW=0.                                                          PLMDEFS  61
      CCPNW=0.                                                          PLMDEFS  62
      CCJ=1.                                                            PLMDEFS  63
      CCP=(P-PPA)/CCJ                                                   PLMDEFS  64
   70 DPX=DPS**2*RG8/2.                                                 PLMDEFS  65
      P=PZ+DPDX*XO                                                      PLMDEFS  66
      C1=DPX/P                                                          PLMDEFS  67
      Q=C1*X(2,2)/X(1,2)                                                PLMDEFS  68
      KL=3                                                              PLMDEFS  69
      AK = 0.                                                           PLMDEFS  70
      CO=RZ**2                                                          PLMDEFS  71
      X(1,2)=AINT(X(1,2))+P/2116216.                                    PLMDEFS  72
      DO111J=3,MR                                                       PLMDEFS  73
      CO=CO+Q*(AK+.3333)                                                PLMDEFS  74
      IF(J.LT.JNW) GO TO 80                                             PLMDEFS  75
      IF(J.GT.JNW) GO TO 80                                             PLMDEFS  76
      P=P-CCP                                                           PLMDEFS  77
      C1=DPX/P                                                          PLMDEFS  78
   80 AK=AK+1.                                                          PLMDEFS  79
      Q=C1*X(2,J)/X(1,J)                                                PLMDEFS  80
      CO=CO+Q*(AK-.3333)                                                PLMDEFS  81
      X(5,KL)=SQRT(CO)                                                  PLMDEFS  82
      X(1,J)=AINT(X(1,J))+P/2116216.                                    PLMDEFS  83
  110 KL=KL+1                                                           PLMDEFS  84
      IF(IG)113,111,112                                                 PLMDEFS  85
  111  DPS=DPS*SQRT((R8**2-RZ**2)/(X(5,NSO)**2-RZ**2))                  PLMDEFS  86
      PSIO=DPS*(NSO-1)*PCODE                                            PLMDEFS  87
      IG=-1                                                             PLMDEFS  88
      GO TO 70                                                          PLMDEFS  89
  113 IG=1                                                              PLMDEFS  90
      ADK=(X(5,MR-1)-RX)/2.                                             PLMDEFS  91
  112 IK=1                                                              PLMDEFS  92
      LM=1                                                              PLMDEFS  93
      X(5,1)=XO                                                         PLMDEFS  94
      X(5,2)=RZ                                                         PLMDEFS  95
       IF(MR.GE.28)LM=2                                                 PLMDEFS  96
       IF(MR.GE.55)LM=3                                                 PLMDEFS  97
       IF(MR.GE.82)LM=4                                                 PLMDEFS  98
      L =MR+LM                                                          PLMDEFS  99
      KL=L +1                                                           PLMDEFS 100
      DO 584 IZ=KL,100                                                  PLMDEFS 101
  584 X(5,IZ)=0.                                                        PLMDEFS 102
      DO 127 J=2,L,LM                                                   PLMDEFS 103
      XX(1,IK,K)=X(5,J)                                                 PLMDEFS 104
      XX(5,IK,K)=X(1,J)                                                 PLMDEFS 105
      IF(X(1,J).LE.0.) KERR=1                                           PLMDEFS 106
      DO 126 I=2,4                                                      PLMDEFS 107
      IF(X(I,J).LT.0.) KERP=1                                           PLMDEFS 108
  126 XX(I,IK,K)=X(I,J)                                                 PLMDEFS 109
  127 IK=IK+1                                                           PLMDEFS 110
      NRD(K)=IK-1                                                       PLMDEFS 111
      IK=NRD(K)                                                         PLMDEFS 112
      XX(1,IK,K)=XX(1,IK-1,K)*1.01                                      PLMDEFS 113
      IF(DPDX.EQ.0.) DX(K)=PA                                           PLMDEFS 114
      ST(K)=XO                                                          PLMDEFS 115
```

```
      IF(DPDX.GT.0.) KERR=200                                          PLMDEF$  116
      IF(KERR.GT.0) GO TO 400                                          PLMDEF$  117
      K=K+1                                                            PLMDEF$  118
      IF(K.GT.40) GO TO 400                                            PLMDEF$  119
C                                                                      PLMDEF$  120
C     EVALUATE ALL PARAMETERS AT N+1 AND STORE                         PLMDEF$  121
C                                                                      PLMDEF$  122
      AXX = AXX+ABX*DXPO                                               PLMDEF$  123
      ABX=ABX+.5                                                       PLMDEF$  124
      NB=1                                                             PLMDEF$  125
      IF(NQ.EQ.0) GO TO 121                                            PLMDEF$  126
      DAJX=XO/B.-ADR                                                   PLMDEF$  127
      IF(DAJX.LE.0.) GO TO 121                                         PLMDEF$  128
      NQ=0                                                             PLMDEF$  129
  121 CONTINUE                                                         PLMDEF$  130
      IP=2                                                             PLMDEF$  131
      NC=MR                                                            PLMDEF$  132
      UP=X(1,1)                                                        PLMDEF$  133
      UQ=UP-1.                                                         PLMDEF$  134
      UP=UP+1.                                                         PLMDEF$  135
      DO 115 I=3,MR                                                    PLMDEF$  136
      NRX=I+1                                                          PLMDEF$  137
      IF(X(1,I).GE.UQ) GO TO 119                                       PLMDEF$  138
      UQ=X(1,I)-1.                                                     PLMDEF$  139
      NC=I                                                             PLMDEF$  140
  119 IF(X(1,I).LE.UP) GO TO 114                                       PLMDEF$  141
      UP=X(1,I)                                                        PLMDEF$  142
      IP=I                                                             PLMDEF$  143
  114 IF(NRX.GT.NC+1) GO TO 116                                        PLMDEF$  144
  115 CONTINUE                                                         PLMDEF$  145
  116 IF(K.GT.2) GO TO 125                                             PLMDEF$  146
      AM2=X(1,IP)/SORT(AL*X(2,IP))                                     PLMDEF$  147
      GO TO 125                                                        PLMDEF$  148
  123 XO = XO-DX                                                       PLMDEF$  149
      DX = DX*QDX                                                      PLMDEF$  150
  125 XO=XO+DX                                                         PLMDEF$  151
      DO 10 IZ= 6,500                                                  PLMDEF$  152
   10 Y(IZ,1) = 0.                                                     PLMDEF$  153
      IF(NSL.GT.1) GO TO 131                                           PLMDEF$  154
      IF(MR.LE.NRO) GO TO 131                                          PLMDEF$  155
      LQ=MR/NRO+1                                                      PLMDEF$  156
      MR=MR/LQ+1                                                       PLMDEF$  157
      NSO=(NSO-2)/LQ+2                                                 PLMDEF$  158
      NRX=(NFX-2)/LQ+2                                                 PLMDEF$  159
      QDX=LQ                                                           PLMDEF$  160
      DRU=QDX*DRO                                                      PLMDEF$  161
      DPS=QDX*DPS                                                      PLMDEF$  162
      NSL=NSK                                                          PLMDEF$  163
      DO 503 I=1,4                                                     PLMDEF$  164
      DO 501 J=2,MR                                                    PLMDEF$  165
      L=LQ*(J-2)+2                                                     PLMDEF$  166
  501 X(I,J)=X(I,L)                                                    PLMDEF$  167
      IZ=MR+1                                                          PLMDEF$  168
      DO 502 J=IZ,180                                                  PLMDEF$  169
  502 X(I,J)=0.                                                        PLMDEF$  170
  503 X(I,1)=X(I,3)                                                    PLMDEF$  171
      MR=MR+1                                                          PLMDEF$  172
```

```
  216 IZ=MR+ODX+5
      DO 218 I=MR,IZ
      X(1,I)=AINT(UA)+PA/1080.
      X(2,I )=TA
      X(3,I )=XCO2A
      X(4,I )=XH2OA
  218 CONTINUE
      IF(ODX.EQ.0.) GO TO 450
      GO TO 123
  131 JG=1
      CZA=0.
      IF(XF.LE.0.) GO TO 128
      RZ=RZ-DX*RF/XF
      IF(RZ.LT.0.)RZ=0.
  128 PSI=0.
      AK=0.
      IF(NRX.LT.MR) GO TO 129
      NQ=2
      NRX=MR-1
  129 LS=2
      LF=NRX
      IF(DPDX.EQ.0.) GO TO 153
      P=PZ+DPDX*XO
      IF(P-PPA)152,152,154
  152 P=PPA
      DPDX=0.
      PZ=P
  153 CC=0.
      CT=0.
      CU=0.
      GO TO 159
  154 CC=DPDX*DX*RG8/P
      DX(K)=P/2116.216
      CT=CC*X(2,2)
      CU=CT*32.17/X(1,2)
      CT=CT/778.2/CP(1)
  159 CONTINUE
      C1=P/RG8/2.
      Q=C1*X(2,2)/X(1,2)
      CO=(RZ*P/RG8)**2
      JNW=MR
  176 CONTINUE
      TH=X(2,LS)/X(2,LF+1)
      AMH=SQRT(X(1,LS)**2/(X(2,LS)*A1))
      IF(JG.GT.1) AMH=AMH*SQRT(A1/2403.)
      J=2*K+JG-2
      XX(J,1,50)=AMH
      AMCH=1.
      IF(AMH.GT..6) AMCH=1.6/(AMH+1.0)
      AMU=XO*(X(1,LS)-X(1,LF+1))*AMCH/TH**2
      AMU=ABS(AMU/CNST)
      LS=LS+1
      DO1A)J=LS,LF
      CO=CO+Q*(AK+.3333)
      PSI=PSI+DPS
      CCJ=0.
      CCP=0.
```

```
      IF(J.LT.JNW) GO TO 191                                            PLMDEFS  230
      IF(J.GT.JNW) GO TO 192                                            PLMDEFS  231
      CCJ=CCJNW                                                         PLMDEFS  232
      CCP=CCPNW                                                         PLMDEFS  233
      GO TO 192                                                         PLMDEFS  234
  191 CONTINUE                                                          PLMDEFS  235
      IF((ABS(PSI-PSIO)-DPS/2)*(2-JG).GE.0) GO TO 192                   PLMDEFS  236
      JNW=J                                                             PLMDEFS  237
      CCJ=CC                                                            PLMDEFS  238
      CCP=(P-PPA)                                                       PLMDEFS  239
      CCPNW=CCP                                                         PLMDEFS  240
      CCJNW=CCJ                                                         PLMDEFS  241
  192 CONTINUE                                                          PLMDEFS  242
      P=P-CCP                                                           PLMDEFS  243
      C1=P/RG8/2.                                                       PLMDEFS  244
      Q=C1*X(2,J)/X(1,J)                                                PLMDEFS  245
      AK=AK+1.                                                          PLMDEFS  246
      CQ=CQ+Q*(AK-.3333)                                                PLMDEFS  247
      CZ=DX*AMU*Y(1,J)*CQ/(2.*(PSI*X(2,J))**2)                          PLMDEFS  248
      IF(CZ.LE.CZM) GO TO193                                            PLMDEFS  249
      CZM=CZ                                                            PLMDEFS  250
  193 CONTINUE                                                          PLMDEFS  251
      LU=J+1                                                            PLMDEFS  252
      LO=J-1                                                            PLMDEFS  253
      CC=CC-CCJ                                                         PLMDEFS  254
      CJ=CC*X(2,J)                                                      PLMDEFS  255
      CX=0.                                                             PLMDEFS  256
      DO 190 I=3,4                                                      PLMDEFS  257
  190 CX=CX+(X(I,LU)-X(I,LO))*CP(I)                                     PLMDEFS  258
      DO 200 I=1,4                                                      PLMDEFS  259
      Y(I,J-1)=Y(I,J-1)+CZ*(X(I,J)-X(I,LO))/PR(I)                       PLMDEFS  260
      Y(I,J)=Y(I,J)+CZ*(X(I,LU)+X(I,LO)-                                PLMDEFS  261
     12.*X(I,J))/PR(I)+X(I,J)                                           PLMDEFS  262
  200 Y(I,J+1)=CZ*(X(I,J)-X(I,LU))/PR(I)                                PLMDEFS  263
      Y(1,J)=Y(1,J)-CJ*32.17/X(1,J)                                     PLMDEFS  264
      XMIX=(Y(3,J)-XCO2A)/(XCO2NE-XCO2A)                                PLMDEFS  265
      CP(1)=.25*(1.-XMIX)+CP(2)*XMIX                                    PLMDEFS  266
      Y(2,J)=Y(2,J)+CJ/778.2/CP(1)                                      PLMDEFS  267
      Y(2,J)=Y(2,J)+CZ*((X(1,LU)-X(1,LO))**2/                           PLMDEFS  268
     1250.E4,+CX*(X(2,LU)-X(2,LO)))/CP(1)/2./PR(2)                      PLMDEFS  269
  180 CONTINUE                                                          PLMDEFS  270
      IF(JG.EQ.2) GO TO 179                                             PLMDEFS  271
      XX(2*K,1,50)=XX(2*K-2,1,50)                                       PLMDEFS  272
      LS=LF                                                             PLMDEFS  273
      LF=MR                                                             PLMDEFS  274
      JG=2                                                              PLMDEFS  275
      GO TO 176                                                         PLMDEFS  276
  179 CONTINUE                                                          PLMDEFS  277
      CCJ=CCJNW                                                         PLMDEFS  278
      CCP=CCPNW                                                         PLMDEFS  279
      QDX=1.                                                            PLMDEFS  280
      QCZ   =CZAV/CZM                                                   PLMDEFS  281
      CZ=ABS(CZM-CZAV)                                                  PLMDEFS  282
      IF(CZ.LT.CZR) GO TO 181                                           PLMDEFS  283
      QDX=1.2+.9*QCZ)/(1.+.1*QCZ)                                       PLMDEFS  284
      GO TO 123                                                         PLMDEFS  285
  181 NSL=NSL-1                                                         PLMDEFS  286
```

```
      DO 215 I=1,4                                              PLMDEFS   287
      DO210J=3,MR                                               PLMDEFS   288
  210 X(I,J)=Y(I,J)                                             PLMDEFS   289
      X(I,2)=X(I,2)+4.*Y(I,2)                                   PLMDEFS   290
      X(I,3)=X(I,3)-Y(I,2)                                      PLMDEFS   291
      Y(I,3)=0.                                                 PLMDEFS   292
      Y(I,2)=0.                                                 PLMDEFS   293
  215 X(I,1)=X(I,3)                                             PLMDEFS   294
      X(1,2)=AINT(X(1,2)-CU)                                    PLMDEFS   295
      X(2,2)=X(2,2)+CT                                          PLMDEFS   296
      G=ABS(X(2,MR)-TA-4.)                                      PLMDEFS   297
      IF(G.GT.5.) MR=MR+1                                       PLMDEFS   298
      IF(N3.LE.NASO) GO TO 250                                  PLMDEFS   299
      AXX=XO-DX                                                 PLMDEFS   300
  250 NR=N3+1                                                   PLMDEFS   301
      DDX=0.                                                    PLMDEFS   302
      IF(X(1,MR+2).LT.0.1) GO TO 216                            PLMDEFS   303
  450 CONTINUE                                                  PLMDEFS   304
      IF(XO-AXX)121,121,70                                      PLMDEFS   305
  400 CONTINUE                                                  PLMDEFS   306
      IF(DPDX.LT.0..AND.AM2.LT.1.) WRITE(6,2200)PA,PB,AM2       PLMDEFS   307
  401 CONTINUE                                                  PLMDEFS   308
      WRITE(6,2100) DPDX                                        PLMDEFS   309
 2100 FORMAT(12X,*DPDX = *,F12.6)                               PLMDEFS   310
 2200 FORMAT(1H1/10X,31HINCOMPATIBLE EXHAUST CONDITIONS//       PLMDEFS   311
     110X,3HPA=,F8.3,3HPB=,F8.3,8HMACH NO=,F8.3)                PLMDEFS   312
      END                                                       PLMDEFS   313
```

```
      OVERLAY(XRMP,4,1)
      PROGRAM FLINP
C      FLOW FIELD INPUT
C
      COMMON/LINK2/STAN(3)
*  FFL
      COMMON/FFL/RZ,NQ,NBSO,CP(4),RX,P,NS,PZ,
     1   PPA,RSS,A1,DP,DX,NRO,K,TMW,XCO2NE,
     2GMd,PR(5),DPS,AM2,KERR,DRO,X(5,100),Y(5,100),MR,CNST
*   PLM   *
      COMMON/PLM/PLMGJ(43),RCN,ST(50),NRD(50),PLM(5,30,50),NFLM,PA,P8,
     1   DPDY,KDATA,ISHK,JSHK,TANE,EQR
*  ATMOS
      COMMON/ATMOS/ALT,FLTM,METEC,RREC,RAMP,RAMT,DELT2,THET2
*  FL
      COMMON/FL/UA,TA,XCO2A,XH2OA,BX(50)
*  GEO
      COMMON /GEO/
     1   A8,       AL,       B8,       DDS,      NEN,      NP,
     2   R8,       R80,      R8Z,      REN(10),  RF,       RO,
     3   ROZ,      RP,       RPZ,      SC,       SS,       TANA,
     4   TNB,      TANP,     XC,       XEN(10),  XF,       XO,
     5   XP,       REND
      DIMENSION PS(100),T8T(100),XCO2(100),XH2O(100),U8(100),TS(100)
      EQUIVALENCE (T8T(1),PLM(101,1,1)),(U8(1),PLM(201,1,1))
      EQUIVALENCE (XCO2(1),PLM(301,1,1)),(XH2O(1),PLM(401,1,1))
      NAMELIST/PLUMIN/  RPN, RSN,          XP,       RP,       KDATA,
     1   TANE,     EQR,      XCO2,     XH2O,     XCO2A,    XH2OA,
     2   U8,       T8T,      P8,  PQ,  UA,       TA,       PA
C        GIVE RPN,RCN,XP,RP,KDATA ONLY IF "INPUT" IS NOT USED.
C        GIVE XCO2,U8, ONLY IF XH2O,T8T, P8,PQ, ARE ALSO GIVEN.
C        GIVE UA,TA,PA XCO2A,XH2OA ONLY IF ALTPLM IS NOT GIVEN IN
C     "INPUT" & DEFAULT IS NOT DESIRED.
C        IF XCO2 ONLY IS OMITTED, XCO2 & XH2O WILL BE CALCULATED.
C        GIVE TANE & OR EQR ONLY IF DEFAULT VALUES ARE NOT DESIRED.
C
C     INITIALIZE
C
      DO 100 IZ=1,50
  100 BX(IZ)=0.
      ST(1)=XO
      DO 300 IZ=1,1000
  300 X(IZ,1)=0.
      TA=519.
      NBS=200
      PQ=P8
      KERR=0
      XH2OA=.00033
      XCO2A=.00033
      EQR=.250
      TANE=9.0
      TMW=28.9665
      DO 301 I=1,100
      XCO2(I)=XCO2A
  301 XH2O(I)=XH2OA
      RPN=REN(2)
      RSN=REN(3)
```

```
      RG8=53.38                                                         PLUME  59
      GM8=1.73                                                          PLUME  60
      PR(1)=1.                                                          PLUME  61
      PR(2)=.5                                                          PLUME  62
      PR(3)=1.                                                          PLUME  63
      PR(4)=1.                                                          PLUME  64
      PR(5)=1.                                                          PLUME  65
      DPS=.025                                                          PLUME  66
      CP(1)=.25                                                         PLUME  67
      CP(2)=0.                                                          PLUME  68
      CP(3)=.31                                                         PLUME  69
      CP(4)=5.4                                                         PLUME  70
      UA=10.                                                            PLUME  71
      READ(5,PLUMIN)                                                    PLUME  72
         IF(NFLW.EQ.0) WRITE(6,PLUMIN)                                  PLUME  73
      NR=-SN*10./RPN+1.005                                              PLUME  74
      R8=RCN=RPN                                                        PLUME  75
      P=PQ                                                              PLUME  76
      CALL THRUST                                                       PLUME  77
      DO 360 J=1,11                                                     PLUME  78
      U8(J)=PLMGD(22)                                                   PLUME  79
  360 T8T(J)=PLMGD(17)                                                  PLUME  80
      PQ=PLMGD(25)                                                      PLUME  81
      DO 361 J=12,NR                                                    PLUME  82
      U8(J)=PLMGD(23)                                                   PLUME  83
  361 T8T(J)=PLMGD(18)                                                  PLUME  84
      NR=NR+1                                                           PLUME  85
      DO 362 J=NR,100                                                   PLUME  86
      U8(J)=UA                                                          PLUME  87
  362 T8T(J)=RAMT                                                       PLUME  88
  302 CONTINUE                                                          PLUME  89
      IF(P8.EQ.0.) P8=PA                                                PLUME  90
      IF(N8S.GT.400) N8S=400                                            PLUME  91
         IF(XCO2(1).LE.1.1*XCO2A) CALL CHEM                             PLUME  92
         IF(XCO2(1).LE.1.1*XCO2A) GO TO 999                             PLUME  93
      RX=RCN                                                            PLUME  94
      RN=RP                                                             PLUME  95
      RZ=RP                                                             PLUME  96
      RF=RP                                                             PLUME  97
      XF=XP                                                             PLUME  98
      A1=GM8*32.17*RG8                                                  PLUME  99
      A=PLMGD(28)                                                       PLUME 100
      CP(3)=CP(3)*44.01/29.17                                           PLUME 101
      CP(4)=CP(4)*2.016/29.17                                           PLUME 102
      IF(UA.LT.(.01*U8(1)))UA=.01*U8(1)                                 PLUME 103
      NBSO=NBS                                                          PLUME 104
      IF(NR.GT.11) NQ=1                                                 PLUME 105
      NRO=NR-1                                                          PLUME 106
      NS=4                                                              PLUME 107
    2 IF(NR*NS.LT.75) GO TO 6                                           PLUME 108
      NS=NS-1                                                           PLUME 109
      GO TO 2                                                           PLUME 110
    6 NR=NR*NS-NS+1                                                     PLUME 111
      NSU=NS*10+1                                                       PLUME 112
      IG=0                                                              PLUME 113
      DO 3 J=1,NRO                                                      PLUME 114
      K=NR+1-J-IG                                                       PLUME 115
```

```
      M=NRO+2-J                                                         PLUME 116
      AK=0.                                                             PLUME 117
      DO 7 L=1,NS                                                       PLUME 118
      LK=K+1-L                                                          PLUME 119
      U8(LK)=U8(M)*(1.-AK)+AK*U8(M-1)                                   PLUME 120
      T8T(LK)=T8T(M)*(1.-AK)+AK*T8T(M-1)                                PLUME 121
      XCO2(LK)=XCO2(M)*(1.-AK)+AK*XCO2(M-1)                             PLUME 122
      XH2O(LK)=XH2O(M)*(1.-AK)+AK*XH2O(M-1)                             PLUME 123
    7 AK=AK+1/NS                                                        PLUME 124
    3 IG=IG+NS-1                                                        PLUME 125
      PPA=2116.216*PA                                                   PLUME 126
      P=2116.216*P8                                                     PLUME 127
      IF(PQ.EQ.0.) PQ=PA                                                PLUME 128
      PPQ=2116.216*PQ                                                   PLUME 129
       DPDX=(PPA-P)/(2.*R8)                                             PLUME 130
        IF(2.*PFN*ABS(DPDX)/P.LT.0.01) DPDX=0.0                         PLUME 131
      PZ=PPQ                                                            PLUME 132
      TS(1)=T8T(1)-A*U8(1)**2                                           PLUME 133
      AM2=SQRT(U8(1)**2/A1/TS(1))                                       PLUME 134
      WRITE(6,1000)                                                     PLUME 135
      RAD=PZ                                                            PLUME 136
       DR=(P8-PZ)/(NS*10.)                                              PLUME 137
      DO 4 I=1,NR,NS                                                    PLUME 138
      WRITE(6,2100) RAD,U8(I),T8T(I),XCO2(I),XH2O(I)                    PLUME 139
    4 RAD=RAD+DR*NS                                                     PLUME 140
      WRITE(6,3200)                                                     PLUME 141
 3200 FORMAT( 1X,21H** AMBIENT CONDITIONS/ )                            PLUME 142
      WRITE(6,2100) RAD,UA,TA,XCO2A,XH2OA                               PLUME 143
      WRITE(6,3300)P8,PA,CP(1),RG8,GM8,AM2                              PLUME 144
 3300 FORMAT(/1X,19H** INPUT PARAMETERS//                               PLUME 145
     130X,17HPLUME        AMBIENT//                                     PLUME 146
     25X,17HPRESSURE,       P ,2(F13.3),7H ATMOS./                      PLUME 147
     35X,17HSPECIFIC HEAT, CP,F13.3,9H BTU/LB-F/                        PLUME 148
     45X,17HGAS CONSTANT,   R ,F13.3,5H FT/F/                           PLUME 149
     55X,17HSP. HT. RATIO     ,F13.3/                                   PLUME 150
     65X,17HMACH NUMBER       ,F13.3)                                   PLUME 151
      IF(NR.LT.NS*10+2) GO TO 5                                         PLUME 152
      WRITE(6,3400) PQ                                                  PLUME 153
 3400 FORMAT(5X,17HSECONDARY PRESS.=,F13.3,7H ATMOS.)                   PLUME 154
    5 NRO=NR/2+5                                                        PLUME 155
      DRO=DR                                                            PLUME 156
C                                                                       PLUME 157
C     EVALUATE PSI(R)                                                   PLUME 158
C                                                                       PLUME 159
      Q=U8(1)/TS(1)                                                     PLUME 160
      PS(1)=0.                                                          PLUME 161
      AX=PPQ/P                                                          PLUME 162
      DO10 J=2,NR                                                       PLUME 163
        IF(J.GT.10*NS+1) A=PLMGD(29)                                    PLUME 164
      TS(J)=T8T(J)-U8(J)**2*A                                           PLUME 165
      PS(J)=PS(J-1)+Q*(3.*RN+DR)                                        PLUME 166
      RN=RN+DR                                                          PLUME 167
      Q=U8(J)/TS(J)                                                     PLUME 168
      IF(J.GE.NS*10+2) Q=Q*AX                                           PLUME 169
   10 PS(J)=PS(J)+Q*(3.*RN-DR)                                          PLUME 170
   11 DO 15 J=1,NR                                                      PLUME 171
   15 PS(J)=SQRT(PS(J))                                                 PLUME 172
```

```
      DPS=PS(NSO)/(NS*10)
      J1=2
      L=0
      Z=PS(1)
   20 Z=Z+DPS
      IF(L.GE.98) GO TO 51
      L=L+1
      DO30J=J1,NP
         IF(PS(J).GT.Z-DPS/1000.) GO TO 40
   30 CONTINUE
      GOTO50
   40 J1=J
      G=(Z-PS(J-1))/(PS(J)-PS(J-1))
      M=L+1
      G1=1.-G
      X(1,M)=G*U0(J)+G1*U0(J-1)
      X(2,M)=G*TS(J)+G1*TS(J-1)
      X(3,M)=G*XCO2(J)+G1*XCO2(J-1)
      X(4,M)=G*XH2O(J)+G1*XH2O(J-1)
      AJ=J
      TAT(M)=RZ+DR*(G*AJ+G1*(AJ-1.))
      GOTO20
   50 MP=L
      M=L+5
      DO 55 NR=MP,M
      X(1,NR)=AINT(UA)+PA/1000.
      X(2,NR)=TA
      X(3,NR)=XCO2A
      X(4,NR)=XH2OA
   55 CONTINUE
      DO 60 I=1,4
      X(I,1)=X(I,3)
      Y(I,2)=0.
      Y(I,3)=0.
   60 X(I,MR+1)=X(I,MR)
      GAMA=TA/(AM2*TS(1))
      CNST=194.
      IF(GAMA-5.)500,500,503
  500 CNST=10.
      IF(GAMA-.2)503,503,501
  501 CNST=(115.*GAMA+7.)/3.
  503 CONTINUE
      CNST=CNST/2.0
      GO TO 400
 1000 FORMAT(1H1/2X,19H** FLOW FIELD INPUT//
     19X,53HRADIUS      VELOCITY    TEMPERATURE      XCO2          XH2O/
     29X,32H(FEET)      (FT/SEC)       (DEG R)//)
 2100 FORMAT(4X,F12.4,2F12.2,3F12.6)
  999 WRITE(6,9999)
      STOP
 9999 FORMAT(10X,40HINCOMPLETE INPUT - CONCENTRATION ERROR. )
  400 CONTINUE
      END
```

```
      SUBROUTINE CHEM                                                   CHEM   2
C                                                                       CHEM   3
C        SIMPLE CHEMICAL ANALYSIS TO YIELD THE COMPOSITION AND BASIC    CHEM   4
C     THERMODYNAMIC PROPERTIES OF THE CORE NOZZLE EXIT PLANE EXHAUST    CHEM   5
C     GAS ASSUMING IDEAL COMBUSTION.                          SET.      CHEM   6
C                                                                       CHEM   7
C   FFL  *    *                                                         CHEM   8
      COMMON/FFL/RZ,NQ,NBSO,CP(4),FX,P,NS,PZ,                           CHEM   9
     1   PPA,RGS,A1,DR,DX,KPO,K,TMW,XCO2NE,                             CHEM  10
     2GMS,PR(5),CPS,AM2,KERR,DRO,X(5,100),Y(5,100),MR,CNST              CHEM  11
C   PLM  *    *                                                         CHEM  12
      COMMON/PLM/PLMGD(43),RCN,ST(50),NRD(50),PLM(5,31,50),NFLW,PA,P3,  CHEM  13
     1   OPOX,KCATA,ISHK,JSHK,TANE,EQR                                  CHEM  14
C                                                                       CHEM  15
C        A LIGHT KEROSENE FUEL IS ASSUMED TO BE BURNED WITH 400%        CHEM  16
C     THEORETICAL AIR FLOW. IE, TANE = 9.8 AND EQR = 0.25.     SET.     CHEM  17
C                                                                       CHEM  18
      DIMENSION SPMV(7),SPMW(7),CPF(7),XCO2(100),XH2O(100)              CHEM  19
      EQUIVALENCE (XCO2(1),PLM(301,1,1)),(XH2O(1),PLM(401,1,1))         CHEM  20
      DATA SPMW/44.010,18.008,28.016,39.944,32.000,12.010,2.016/        CHEM  21
      DATA CPF/.31,.55,.29,.17,.28,.40,3.4/                             CHEM  22
C        CHEM ENGR'S HNDBK, 3RD ED, 2ND IMP, 1950                       CHEM  23
      SPMV(1)=XCO2(100)                                                 CHEM  24
      SPMV(2)=XH2O(100)                                                 CHEM  25
      SPMV(3)=.780881                                                   CHEM  26
      SPMV(4)=.009324                                                   CHEM  27
      SPMV(5)=.209495                                                   CHEM  28
      TMW=0.                                                            CHEM  29
      TMV=0.                                                            CHEM  30
      DO 1 I=1,5                                                        CHEM  31
      TMV=TMV+SPMV(I)                                                   CHEM  32
    1 TMW=TMW+SPMV(I)*SPMW(I)                                           CHEM  33
      DO 10 I=1,5                                                       CHEM  34
   10 SPMV(I)=SPMV(I)/TMV                                               CHEM  35
      CH2K=SPMV(5)*TANE/(1.5*TANE+.5)                                   CHEM  36
      SPMV(6)=CH2K*AMAX1(EQR-1.,0.)                                     CHEM  37
      SPMV(7)=SPMV(6)*(TANE+1.)/TANE                                    CHEM  38
      SPMV(5)=SPMV(5)*AMAX1(1.-EQR,0.)                                  CHEM  39
      SPMV(2)=CH2K*(TANE+1.)*EQR/TANE+SPMV(2)                           CHEM  40
      SPMV(1)=CH2K*EQR+SPMV(1)                                          CHEM  41
      FARV=CH2K*EQR                                                     CHEM  42
      FARW=FARV*(SPMW(6)+(TANE+1.)*SPMW(7)/TANE)/TMW                    CHEM  43
      PLMGD(12)=FARW                                                    CHEM  44
      TCPF=0.0                                                          CHEM  45
      TMV=0.                                                            CHEM  46
      TMW=0.                                                            CHEM  47
      DO 11 I=1,7                                                       CHEM  48
      TMV=TMV+SPMV(I)                                                   CHEM  49
      SPW=SPMW(I)*SPMV(I)                                               CHEM  50
      TMW=TMW+SPW                                                       CHEM  51
   11 TCPF=TCPF+SPW*CPF(I)                                              CHEM  52
      TMV=TMV-SPMV(6)                                                   CHEM  53
      TMW=TMW/TMV                                                       CHEM  54
      TCPF=TCPF/TMV                                                     CHEM  55
      DO 100 I=1,7                                                      CHEM  56
  100 SPMV(I)=SPMV(I)/TMV                                               CHEM  57
      TMV=1.                                                            CHEM  58
```

```
      RG8=1545.8146/TMW                                                 CHEM  59
      CP(1)=TCPF/TMW                                                    CHEM  60
      GM8=1./(1.-1.98588/TCPF)                                          CHEM  61
      CP(2)=CP(1)                                                       CHEM  62
      DO 131 J=1,11                                                     CHEM  63
      XCO2(J)=SPMV(1)                                                   CHEM  64
  131 XH2O(J)=SPMV(2)                                                   CHEM  65
      XCO2NE=SPMV(1)                                                    CHEM  66
      RETURN                                                            CHEM  67
      END                                                               CHEM  68
```

```
      SUBROUTINE THRUST
C
C  FFL  *    *
      COMMON/FFL/RZ,NQ,N9SO,CP(4),RX,P,NS,PZ,
     1   PPA,RGB,A1,DR,DX,NRO,K,TMM,XCO2NE,
     2GMB,PR(5),DPS,AM2,KERR,DRO,X(5,100),Y(5,100),MR,CNST
C  PLM  *    *
      COMMON/PLM/PLMGD(43),RCN,ST(50),NRO(50),PLM(5,30,50),NFLW,PA,P8,
     1   DPDX,KDATA,ISHK,JSHK,TANE,EQR
C  ATMOS * *
      COMMON/ATMOS/ALT,FLTM,METEC,RREC,RAMP,PAMT,DELT2,THET2
C  FL  *  *  *
      COMMON/FL/UA,TA,XCO2A,XH2OA,BX(50)
C
      DIMENSION DAY(3),VICON(4)
C INPUT PARAMETERS- METEC MIL STD 210- <-1=COLD,0=STANDARD,+1=HOT>ALT=FE
C  NORM =0 FOR ABSOLUTE/=1 FOR NORMALIZED,JET = 0,1, OR 2 COANNULAR JETS
C FLTM=MACH,TSFCC=TSFC/SRTHT2(LB/LBHR),RREC=RAM FRACT,FN=THRUST/DELT2(LB
C FNRT=NRT/DELT2(LBS),EPR=PT7/PT2,FPR=PT2.5/PT2,TTPN=TT7/THET2(OR),TTSN=
C TT2.5/THET2(OR),WAPAC=WP*SRTHT2 /DELT2(LBS/SEC),WASAC=WS*SRTHT2 /DELT2
C GAMP & GAMS=SP HT RATIO, ZCPP &    PS=SP HT (BTU/LBOR)>><S E TATE OCT 2
C
      NAMELIST/POWER/          METEC,    NORM,     JET,
     1   FLTM,      TSFCC,     RREC,     FN,       FNRT,
     2   EPR,       FPR,       TTPN,     TTSN,     WAPAC,    WASAC
      METEC=0
      NORM=1
      JET=1
      ALT=PLMGD(5)
      GAMS=1.4
      RS=53.3
      CPS=CP(1)*25028.26
      RREC=1.
      FLTM=UA/SQRT(.4*CPS*TA)
         IF(PLM(201,1,1).GT.1.) GO TO 200
         IF(UA.GT.11.) GO TO 200
      FLTM=.2
      TSFCC=.996
      RREC=1.0
      FN=2593.
      FNRT=2593.
      EPR=2.3298
      FPR=0.
      TTPN=1758.
      TTSN=0.
      WAPAC=43.9
      WASAC=0.
  200 PAC=PA*14.695
      READ(5,POWER)
         IF(NFLW.EQ.0) WRITE(6,POWER)
         IF(F'.NE.0.) ALT=1.E8
         IF(PA.NE.0.) GO TO 210
      EQR=0.
         CALL CHEM
      ZCPS=CP(1)
      RS=RGB
      GAMS=GMB
```

```
      CPS=7CPS*25028.26                                                 THRUST  59
    1 H=.3048*ALT                                                       THRUST  60
      IF (H-11000.)5,5,2                                                THRUST  61
    2 IF (H-20000.)6,6,3                                                THRUST  62
    3 IF (H-32000.)7,7,4                                                THRUST  63
    4 IF (H-47200.)8,8,9                                                THRUST  64
C                                                                       THRUST  65
C     0 TO 11 KILOMETERS OR 0 TO 36,152 FT.                             THRUST  66
C                                                                       THRUST  67
    5 TAC=518.67-.3117*H                                                THRUST  68
      PAC=14.695949E0*((230.15/(288.15-.0065*H))**(-5.2558761E0))       THRUST  69
      GO TO 14                                                          THRUST  70
C                                                                       THRUST  71
C     11 TO 20 KM OR 36,15   65,623 FT.                                 THRUST  72
C                                                                       THRUST  73
    6 TAC=389.97                                                        THRUST  74
      PAC=.64483209E-04*(H-11000.)                                      THRUST  75
      PAC=3.2824941E02/(10.**PAC)                                       THRUST  76
      GO TO 14                                                          THRUST  77
C                                                                       THRUST  78
C     20 TO 32 KM OR 65,623 TO 135,518 FT.                              THRUST  79
C                                                                       THRUST  80
    7 TAC=389.97+.0018*(H-20000.)                                       THRUST  81
      PAC=.79426277E0*((216.65/(216.65+.001*(H-20000.)))**(34.163195E0)) THRUST  82
      GO TO 14                                                          THRUST  83
C                                                                       THRUST  84
C     32 TO 47 KM OR 1.5,518 TO 155,348 FT.                             THRUST  85
C                                                                       THRUST  86
    8 TAC=411.57+.00504*(H-32000.)                                      THRUST  87
      PAC=.12589479E0*((228.65/(228.65+.0028*(H-32000.)),**12.201141E0) THRUST  88
      GO TO 14                                                          THRUST  89
C                                                                       THRUST  90
C     47 TO 52 KM OR 155,348 TO 172,011 FT.                             THRUST  91
C                                                                       THRUST  92
    9 TAC=487.17                                                        THRUST  93
      PAC=.54819461E-04*(H-47000.)                                      THRUST  94
      PAC=.16085411E-01/(10.**PAC)                                      THRUST  95
C        HOT        COLD        HOT        COLD      HOT      COLD      THRUST  96
   14 IF(METEC)16,10,17                                                 THRUST  97
   16 TA=0                                                              THRUST  98
C                                                                       THRUST  99
C   ICAO ^ COLD DAY ^ MIL^STD^210                                       THRUST 100
C                                                                       THRUST 101
      IF(H-1007.)110,110,100                                            THRUST 102
  100 IF(H-3256.)111,111,101                                            THRUST 103
  101 IF(H-9346.)112,112,102                                            THRUST 104
  102 IF(H-12894.)113,113,103                                           THRUST 105
  103 IF(H-15391.)114,114,104                                           THRUST 106
  104 IF(H-18587.)115,115,105                                           THRUST 107
  105 IF(H-22229.)116,116,117                                           THRUST 108
C                                                                       THRUST 109
  110 TAC=399.7+.04467*H                                                THRUST 110
      GO TO 10                                                          THRUST 111
  111 TAC=444.7                                                         THRUST 112
      GO TO 10                                                          THRUST 113
  112 TAC=444.7-.01149*(H-3256.)                                        THRUST 114
      GO TO 10                                                          THRUST 115
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  113 TAC=374.7                                                    THRUST   116
      GO TO 10                                                     THRUST   117
  114 TAC=374.7-.31602*(H-12894.)                                  THRUST   118
      GO TO 10                                                     THRUST   119
  115 TAC=334.7                                                    THRUST   120
      GO TO 10                                                     THRUST   121
  116 TAC=334.7+.008513*(H-18587.)                                 THRUST   122
      GO TO 10                                                     THRUST   123
  117 TAC=365.7-.0011355*(H-22229.)                                THRUST   124
      GO TO 10                                                     THRUST   125
   17 TA=0                                                         THRUST   126
C                                                                  THRUST   127
C     IGAO HOT DAY      MIL^STD^210                                THRUST   128
C                                                                  THRUST   129
      IF(H-11985.)118,118,106                                      THRUST   130
  106 IF(H-20204.)119,119,120                                      THRUST   131
  118 TAC=562.7-.0123456*H                                         THRUST   132
      GO TO 10                                                     THRUST   133
  119 TAC=414.7+.0134183*(H-11988.)                                THRUST   134
      GO TO 10                                                     THRUST   135
  120 TAC=442.7+.00052819*(H-20284.)                               THRUST   136
      GO TO 10                                                     THRUST   137
C       HOT        COLD       HOT        COLD       HOT        COLD THRUST   138
   10 TA = TAC                                                     THRUST   139
  210 CONTINUE                                                     THRUST   140
      PAMB=PAC                                                     THRUST   141
      DELAM=PAMB/14.696                                            THRUST   142
      THLAM=TA/518.688                                             THRUST   143
      IF(JET-2)50,51,50                                            THRUST   144
   50 CONTINUE                                                     THRUST   145
      FPR = 1.                                                     THRUST   146
      WASAC = 0.                                                   THRUST   147
   51 RAMTR=1.+(GAMS-1.)*FLTM*FLTM/2.                              THRUST   148
      FGAMS=(GAMS-1.)/GAMS                                         THRUST   149
      RAMPR=(RAMTR**(1./FGAMS))*RREC                               THRUST   150
      DELT2=DELAM*RAMPR                                            THRUST   151
      THET2=THEAM*RAMTR                                            THRUST   152
      SRTHT2=SQRT(THET2)                                           THRUST   153
      UA=FLTM*SQRT(.*CPS*TA)                                       THRUST   154
      RAMT=518.688*THET2                                           THRUST   155
      RAMP=14.696*DELT2                                            THRUST   156
      IF(NORM)52,52,53                                             THRUST   157
   52 TSFCC=TSFCC/SRTHT2                                           THRUST   158
      FN  =FN  /DELT2                                              THRUST   159
      FNRT=FNRT/DELT2                                              THRUST   160
      EPR=EPR/(RAMPR*PAMB)                                         THRUST   161
      FPR=FPR/(RAMPR*PAMB)                                         THRUST   162
      TTPN = TTPN/RAMTR                                            THRUST   163
      TTSN = TTSN/RAMTR                                            THRUST   164
      WAPAC = WAPAC*SRTHT2/DELT2                                   THRUST   165
      WASAC = WASAC*SRTHT2/DELT2                                   THRUST   166
      IF(JET.NE.2) FFR=1.                                          THRUST   167
   53 CONTINUE                                                     THRUST   168
      WP=WAPAC*DELT2/SRTHT2                                        THRUST   169
      WS=WASAC*DELT2/SRTHT2                                        THRUST   170
      PNRT = FN*100./FNRT                                          THRUST   171
      FN = FN*DELT2                                                THRUST   172
```

```
      WF=TSFCC*FN*SRTHT2
      EQR=1.
        CALL CHEM
      WFSTOIC=WP*3600.*PLMGO(12)
      EQR=WF/WFSTOIC
  220 CONTINUE
        CALL CHEM
      GAMP=GMS
      FGAMP=(GAMP-1.)/GAMP
      ZCPP=CP(1)
      RP=RGB
      CPP=ZCPP*25023.26
      WP=WP+WF/3600.
      PNPR=EPR*RAMPP
      PTP=PNPR*PAMB
      CNTP=(GAMP+1.)/2.
      CNPR=CNTP**(1./FGAMP)
      IF(PNPR.GE.CNPR)PNPR=CNPR
      PNTR=PNPR**FGAMP
      PNMACH=SQRT(2.*(PNTR-1.)/(GAMP-1.))
      SNPR=FPR*RAMPR
      PTS=SNPR*PAMB
      CSPR=((GAMS+1.)/2.)**(1./FGAMS)
      IF(SNPR.GE.CSPR)SNPR=CSPR
      SNTR=SNPR**FGAMS
      SNMACH=SQRT(2.*(SNTR-1.)/(GAMS-1.))
      PNTH =(GAMP-1.)*CPP*TTPN*THET2/PNTR
      IF(JET.NE.2)TTSN = 518.688
      SNTH =(GAMS-1.)*CPS*TTSN*THET2/SNTR
      PNVEL=PNMACH*SQRT(PNTH)
      SNVEL=SNMACH*SQRT(SNTH)
      TTP=TTPN*THET2
      TTS=TTSN*THET2
      RREC = RPEC*100.
      DAY(1) =10H    COLD D
      DAY(2) =10HSTANDARD D
      DAY(3) =10H     HOT D
      VICON(1)=10HEXPECTED.
      VICON(2)=10H
      VICON(3)=10HNOT EXPECT
      VICON(4)=10HED.
      PA=DELAM
      PB=PTP/PNPR/14.69594
      MCON=3
        IF(TA.LT.460..AND.XH2OA.GT.0.0085) MCON=1
      NCON=MCON+1
      PLMGO(1)=DELAM
      PLMGO(2)=THEAM
      PLMGO(3)=METEC+2
      PLMGO(4)=TA
      PLMGO(7)=PNRT
      PLMGO(8)=JET
      PLMGO(9)=WP
      PLMGO(10)=WS
      PLMGO(11)=WF
      PLMGO(13)=PNPR
      PLMGO(14)=SNPR
```

```
      PLMGD(15)=PTP                                                     THRUST
      PLMGD(16)=PTS                                                     THRUST
      PLMGD(17)=TTP                                                     THRUST
      PLMGD(18)=TTS                                                     THRUST
      PLMGD(19)=FN                                                      THRUST
      PLMGD(20)=PNMACH                                                  THRUST
      PLMGD(21)=SNMACH                                                  THRUST
      PLMGD(22)=PNVEL                                                   THRUST
      PLMGD(23)=SNVEL                                                   THRUST
      PLMGD(24)=P8                                                      THRUST
      PLMGD(25)=PTS/SNPR/14.69594                                       THRUST
      PLMGD(26)=RP                                                      THRUST
      PLMGD(27)=RS                                                      THRUST
      PLMGD(28)=FGAMP/(64.34*RP)                                        THRUST
      PLMGD(29)=FGAMS/(64.34*RS)                                        THRUST
      WRITE(6,24)                                                       THRUST
         IF(ALT.GE.1.E7) GO TO 23                                       THRUST
      WRITE(6,25) ALT,DAY(METEC+2),XH2OA                                THRUST
      WRITE(6,26) (VICON(I),I=MCON,NCON)                                THRUST
   23 WRITE(6,27) FLTM,PAMB,TA,UA                                       THRUST
      WRITE(6,28) EQR                                                   THRUST
         IF(EQR.GT.1.05) WRITE(6,40) EQR                                THRUST
   24 FORMAT(//23H** FLIGHT CONDITIONS **)                              THRUST
   25 FORMAT(//5X,*ALTITUDE IS *,F6.0,* FEET,*/5X,*WEATHER IS ICAO MIL S THRUST
     *TO 210 *,R13,*AY* /10X,* WITH *,F10.6,* WATER CONTENT.*)          THRUST
   26 FORMAT(15X,*VISIBLE CONTRAIL IS *,2A10)                           THRUST
   27 FORMAT(5X,*CASE MACH NUMBER IS *,F4.2,* AT AMBIENT* */10X,*PRESSUR THRUST
     *E OF     *,F6.2,* PSIA.*/10X,*TEMPERATURE OF *,F5.0,* DEGR.*/10X, THRUST
     **VELOCITY OF     *,F5.0,* FT/SEC.*//)                             THRUST
   28 FORMAT(5X,*ENGINE IS RUNNING WITH A FUEL EQUIVALENCE RATIO (EQR) O THRUST
     *F *,F6.3//)                                                       THRUST
   40 FORMAT(30X*SMOKEY ENGINE OPERATION -> EQR. =*,G14.4)              THRUST
      RETURN                                                            THRUST
      END                                                               THRUST
```

```
      OVERLAY(XRHP,5,0)
      PROGRAM PLMDM
C   *
C   *    PLUME DATA MANAGEMENT    *    *
C   *
*  INP   *
      COMMON/INP/
     1 D,  DDZ,  DX,  DTST,  DZ,  NDZ,  NOP,  NPRINT,  ZTST
*  GEO  *
      COMMON /GEO/
     1   A5,        AL,        B8,        DDS,        NEN,      NP,
     2   R5,        R8D,       R8Z,       REM(10),    RF,       RO,
     3   RDZ,       RP,        RPZ,       SC,         SS,       TANA,
     4   TN3,       TANP,      XC,        XEN(10),    XF,       XD,
     5   XP,        REND
C PLM    *     *
      COMMON/PLM/PLMGD(43),RCN,ST(50),NRD(50),PLM(5,38,50),NFLM,PA,P8,
     1   DPDX,KDATA,ISHK,JSHK,IANE,EOR
      IREAD=KDATA/10000
      KDATA=KDATA-IREAD*10000
      IF(IREAD-1) 2,1,10
C
C   *    *  READ PLMGD FROM *PF    *    *
    1 READ(8) (PLMGD(I),I=1,7644)
      GO TO 11
C
C   *    *  READ PLMGD FROM INPUT *    *
   10 READ(5,9010)(PLMGD(I),I=1,7644)
 9010 FORMAT(6E12.5)
C
C     RCN      =PLMGD(44)
C ST(50)=PLMGD(45-94),NRD(50)=PLMGD(95-144),PLM(5,38,50)=PLMGD(145-7644)
C
   11 DO 100 I=1,3,2
      XEN(I)=PLMGD(I+34)
  100 REN(I)=PLMGD(I+31)
      RF       =PLMGD(42)
      XF       =PLMGD(43)
      NEN=PLMGD(35)
      NP=2
      P8X=PLM(5,1,2)-INT(PLM(5,1,2))
      P8 =PLM(5,1,1)-INT(PLM(5,1,1))
      DPDX=(P8X-P8)/(PLMGD(46)-PLMGD(45))
      PA=PLM(5,1,49)-INT(PLM(5,1,49))
      GO TO 101
    2 CONTINUE
      DO 20 I=1,3,2
      PLMGD(I+32)=XEN(I)
      PLMGD(I+31)=REN(I)
   20 CONTINUE
      PLMGD(42)=RF
      PLMGD(43)=XF
      PLMGD(35)=NEN
      NRD(49)=0
      JPDF=NPD(1)
      NB=NPD(48)
      ST(43)=1.1*ST(48)
```

```
      DO 22 K=1,49                                                      PLMOM$    59
      JI=MIN0(30,NRD(K)+1)                                              PLMOM$    60
      NRD(K)=JI                                                         PLMOM$    61
      IF(K.EQ.49) NRD(K)=NRD(K-1)                                       PLMOM$    62
      JE=MIN0(30,NRD(K))                                                PLMOM$    63
      DO 22 J=JI,JE                                                     PLMOM$    64
      PLM(1,J,K)=1.2*PLM(1,NB,48)                                       PLMOM$    65
      IF(K.EQ.49) PLM(1,J,K)=PLM(1,J,K-1)                               PLMOM$    66
      DO 22 I=2,5                                                       PLMOM$    67
   22 PLM(I,J,K)=PLM(I,JREF,1)                                          PLMOM$    68
  101 CONTINUE                                                          PLMOM$    69
      DO 110 K=1,49                                                     PLMOM$    70
      JEOG=NRD(K)                                                       PLMOM$    71
      DO110 J=2,JEOG                                                    PLMOM$    72
      VELT=PLM(5,1,K)-1.                                                PLMOM$    73
      VEL=PLM(5,J,K)                                                    PLMOM$    74
      IF(VEL.GE.VELT)GO TO 110                                          PLMOM$    75
      IF(J.LE.2) GO TO 111                                              PLMOM$    76
  110 CONTINUE                                                          PLMOM$    77
  111 K=K-1                                                             PLMOM$    78
      XC=ST(K)                                                          PLMOM$    79
      REN(10)=RCN                                                       PLMOM$    80
      R8=RCN                                                            PLMOM$    81
      RO=RCN                                                            PLMOM$    82
      AL=ST(48)                                                         PLMOM$    83
      NB=NRD(49)-2                                                      PLMOM$    84
      REND=PLM(1,NB,48)                                                 PLMOM$    85
      TN3=(REND-RO)/AL                                                  PLMOM$    86
      WRITE(6,9011) R8,XC,REND,AL                                       PLMOM$    87
 9011 FORMAT(5X,4H R8=,F8.3,4H XC=,F8.3,6H REND=,F8.3,4H AL=,F8.3)      PLMOM$    88
C                                                                       PLMOM$    89
C  *    *  PLUME GAS DATA IS IN CORE  *    *                            PLMOM$    90
C                                                                       PLMOM$    91
      IFILE=KDATA/1000                                                  PLMOM$    92
      KDATA=KDATA-IFILE*1000                                            PLMOM$    93
      IPNCH=KDATA/100                                                   PLMOM$    94
      KDATA=KDATA-IPNCH*100                                             PLMOM$    95
      IPRNT=KDATA/10                                                    PLMOM$    96
      IPLOT=KDATA-IPRNT*10                                              PLMOM$    97
      IF(IFILE.NE.1) GO TO 1000                                         PLMOM$    98
      WRITE(8) (PLMGO(I),I=1,7644)                                      PLMOM$    99
 1000 IF(IPNCH.NE.1) GO TO 1001                                         PLMOM$   100
      PUNCH9013,(PLMGO(I),I=1,7644)                                     PLMOM$   101
 1001 IF(IPRNT.NE.1) GO TO 1010                                         PLMOM$   102
      CALL PLMPRNT                                                      PLMOM$   103
 1010 KDATA=IPLOT                                                       PLMOM$   104
      CALL PLMPLT                                                       PLMOM$   105
      END                                                               PLMOM$   106
```

```
      SUBROUTINE PLMPRNT
C
C   *     *  PRINTS PLUME GAS DATA *     *
C
C   * PLM *
      COMMON/PLM/PLMGD(43),RCN,ST(50),NRD(50),PLM(5,30,50),NFLM,PA,PB,
     1   DPDX,KDATA,ISHK,JSHK,TANE,EOR
      K=1
      LINES=65
    1 IF(LINES.LT.60) GO TO 10
      WRITE(6,9001)
      LINES=NPD(K)+3
   10 JREF=NPD(K)
      WRITE(6,9010) K,ST(K),(PLM(2*K-2+I,6,50),I=1,2)
      DO 11 J=1,JREF
      VEL=ATNT(PLM(5,J,K))
      PRES=(PLM(5,J,K)-VEL)*1000.
      RAD=PLM(1,J,K)
   11 WRITE(6,9011) RAD,VEL,PRES,(PLM(I,J,K),I=2,4)
      K=K+1
      LINES=LINES+NPD(K)+3
      IF(K-50) 1,100
 9001 FORMAT(1H1,50X,24H0==* PLUME GAS DATA *==>/,1H0,T12,*RADIUS (FEET)
     *    *,T31,*VELOCITY (FT/SEC)*,T52,*PRESSURE (ATM)*,T72,*STAT TEMP (
     **DEG R)*,T93,*XCO2 (MOL FRAC)*,T113,*XH2O (MOL FRAC)*)
 9010 FORMAT(1H0,5X,*STATION # = *,I2,5X,*STATION X *,F7.2,5X*CENTERLINE
     * MACH = *,F6.3,5X,*EDGE MACH = *,F6.3/,1H0)
 9011 FORMAT(T17,F7.2,T38,F5.0,T55,F8.5,T78,F5.0,T96,F8.6,T116,F8.6)
  100 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE PLMPLT                                                 PLMPLT   2
C                                                                       PLMPLT   3
C  OBJECTIVES TO PLOT ON THE PRINTER FROM TABLE PLM ANY ARGUMENT(IPLOT) PLMPLT   4
C     FROM 2 THROUGH 5 OR ALL ARGUMENTS 2 THROUGH 5 (IPLOT=0), OR       PLMPLT   5
C     NONE AT ALL (IPLOT=1).                                            PLMPLT   6
C                                                                       PLMPLT   7
C  PLMST * * * PLUME STRUCTURE DATA * * *                               PLMPLT   8
      COMMON/PLM/PLMG3(43),RCN,ST(50),NRD(50),PLM(5,30,50),NFLW,PA,P0,  PLMPLT   9
     1   DPDX,KDATA,ISHK,JSHK,TANE,EOR                                  PLMPLT  10
      INTEGER   SYM(133),DYM(7),LAB(11)                                 PLMPLT  11
      DIMENSION FMTV(13),ANS(6),VAR(4),RNG(4)                           PLMPLT  12
      DATA FMTV/13H(2CX** > *,1H ,10H,* > P > *,1H ,10H,* > L > *,      PLMPLT  13
     11H ,10H,* > U > *,1H ,10H,* > M > *,1H ,10H,* > E > *,1H ,2H/)/   PLMPLT  14
      DATA RNG/4HF5.0,5HE10.4,5HE10.4,4HF5.0/                           PLMPLT  15
      DATA VAR/10HSTAT TEMP ,10H CO2 CONC ,10H H2O CONC ,10H VELOCITY / PLMPLT  16
      DATA LAB/1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H0,1H /             PLMPLT  17
      DATA DYM/1H ,1HE,1HM,1HU,1HL,1HP,1H0/                             PLMPLT  18
      DATA EMP/1CH(3X,130A1)/                                           PLMPLT  19
      DATA LMX,KMX,LCN/24,119,11/                                       PLMPLT  20
C                                                                       PLMPLT  21
      IPLOT=KDATA                                                       PLMPLT  22
      JIG=IPLOT                                                         PLMPLT  23
      IF(IPLOT.GT.1) GO TO 0011                                         PLMPLT  24
      JIG=1                                                             PLMPLT  25
 0010 JIG=JIG+1                                                         PLMPLT  26
      IF(JIG.GT.5)IPLOT=1                                               PLMPLT  27
C                                                                       PLMPLT  28
      IF(IPLOT.NE.1) GO TO 0011                                         PLMPLT  29
      GO TO 2202                                                        PLMPLT  30
C                                                                       PLMPLT  31
C       * FILL & WRITE PLOT HEADER      *                               PLMPLT  32
 0011 CONTINUE                                                          PLMPLT  33
      AMX=PLM(JIG,1,1)                                                  PLMPLT  34
      AMN=PLM(JIG,1,49)                                                 PLMPLT  35
       AINC=(AMX-AMN)/5.0                                               PLMPLT  36
      AMN=AMN+.5*AINC                                                   PLMPLT  37
      J=JIG-1                                                           PLMPLT  38
      DO 0909 IFILL=2,12,2                                              PLMPLT  39
      I=IFILL/2                                                         PLMPLT  40
      ANS(I)=AMN+AINC*(6-I)                                             PLMPLT  41
 0909 FMTV(IFILL)=RNG(J)                                                PLMPLT  42
      WRITE(6,0009)                                                     PLMPLT  43
      WRITE(6,0099) VAR(J)                                              PLMPLT  44
      WRITE(6,0900) RCN                                                 PLMPLT  45
      WRITE(6,FMTV)ANS                                                  PLMPLT  46
      DO 0003 NSF=2,48                                                  PLMPLT  47
      AKSF=PLM(JIG,1,NSF)                                               PLMPLT  48
      IF(AKSF.LE.AMN+.4*AINC) GO TO 0030                                PLMPLT  49
 0003 CONTINUE                                                          PLMPLT  50
C       * SET SCALES L & K      *                                       PLMPLT  51
 0030 SCLK=ST(NSF)/KMX                                                  PLMPLT  52
      SCLL =SCLK/.60                                                    PLMPLT  53
      LCN=RCN/SCLL+1.0                                                  PLMPLT  54
      IF(LCN.LE.1) GO TO 0004                                           PLMPLT  55
      SCLL=RCN/(LCN-1)                                                  PLMPLT  56
      SCLK=.6*SCLL                                                      PLMPLT  57
      NSF=NSF+1                                                         PLMPLT  58
```

```
      IF(LCN.GE.5) GO TO 0033                                        PLMPLT   59
 0004 NSF=NSF-2                                                      PLMPLT   60
      GO TO 0030                                                     PLMPLT   61
 0033 IF(NSF.EQ.48) GO TO 0300                                       PLMPLT   62
      IF(LCN.LE.15) GO TO 0300                                       PLMPLT   63
      NSF=NSF+5                                                      PLMPLT   64
      IF(NSF.GT.48) NSF=48                                           PLMPLT   65
      GO TO 0030                                                     PLMPLT   66
 0300 NRF=NRD(NSF)-2                                                 PLMPLT   67
      RF=PLM(1,NRF,NSF)                                              PLMPLT   68
      ORF=RF/RCN                                                     PLMPLT   69
      LMXT=LCN*ORF+1                                                 PLMPLT   70
      IF(LMXT.GE.26) GO TO 0303                                      PLMPLT   71
      LMX=LMXT                                                       PLMPLT   72
 0303 CONTINUE                                                       PLMPLT   73
      LT=2*LMX                                                       PLMPLT   74
C                                                                    PLMPLT   75
C        * SET UP PRINTER LINE L LOOP    *                           PLMPLT   76
      DO 1111 L=1,LT                                                 PLMPLT   77
      LR=IABS(L-LMX)                                                 PLMPLT   78
      RL=LR*SCLL                                                     PLMPLT   79
         PRMO=PLM(1,1,1)                                             PLMPLT   80
      KMO=1                                                          PLMPLT   81
      STL=3.                                                         PLMPLT   82
      DO 0001 IZ=1,130                                               PLMPLT   83
 0001 SYM(IZ)=1H                                                     PLMPLT   84
C                                                                    PLMPLT   85
C        * SET UP PRINT CHARACTER K LOOP   *                         PLMPLT   86
      DO 1110 KPO=1,NSF                                              PLMPLT   87
      STA=ST   (O)                                                   PLMPLT   88
      KS=STA/SCLK+1                                                  PLMPLT   89
      NRK=NRD(KPO)-2                                                 PLMPLT   90
      RMX=PLM(1,NRK,KPO)                                             PLMPLT   91
      IF(RMX.GE.RL) GO TO 0100                                       PLMPLT   92
      A=AMN-.5*AINC                                                  PLMPLT   93
      LEV=1                                                          PLMPLT   94
      GO TO 1000                                                     PLMPLT   95
C                                                                    PLMPLT   96
 0100 ARMO=0.0                                                       PLMPLT   97
      PR=PLM(1,1,KPO)                                                PLMPLT   98
         LEV=0                                                       PLMPLT   99
         A=0.0                                                       PLMPLT  100
      RMO=0.                                                         PLMPLT  101
C                                                                    PLMPLT  102
C  SEARCH RAD NO TO FIT RAD RL                                       PLMPLT  103
      DO 0101 NR=1,NRK                                               PLMPLT  104
      RK=PLM(1,NR,KPO)                                               PLMPLT  105
      AK=PLM(JIG,NR,KPO)                                             PLMPLT  106
      IF(RK.GT.RL) GO TO 0110                                        PLMPLT  107
      RMO=RK                                                         PLMPLT  108
 0101 ARMO=AK                                                        PLMPLT  109
 0110 QR=(RL-RMO)/(RK-RMO)                                           PLMPLT  110
      IF(NR.EQ.1) GO TO 1000                                         PLMPLT  111
      IF(KPO.EQ.1) QR=0.0                                            PLMPLT  112
      A=QR*(AK-ARMO)+ARMO                                            PLMPLT  113
C                                                                    PLMPLT  114
C  SEARCH LEVEL OF ARGUEMENT                                         PLMPLT  115
```

```
      DO 8111 LEV=1,6                                                   PLMPLT   116
      AT=AMN+AINC*(LEV-1)                                               PLMPLT   117
      IF(A.LT.AT) GO TO 1000                                            PLMPLT   118
 8111 CONTINUE                                                          PLMPLT   119
C  FALLS OUT WITH A>AMX                                                 PLMPLT   120
      LEV=7                                                             PLMPLT   121
      AT=AT+AINC                                                        PLMPLT   122
 1000 IF(KS.GT.1) GO TO 1001                                            PLMPLT   123
      LEVMO=LEV                                                         PLMPLT   124
 1001 STAT=STA                                                          PLMPLT   125
      IF(LEV.EQ.LEVMO) GO TO 1010                                       PLMPLT   126
      IF(LEVMO.LT.LEV)AT=AT-AINC                                        PLMPLT   127
      IF((A-AMO)/AINC.LT.0.1) AMO=A-.1*AINC                             PLMPLT   128
      OK=(AT-AMO)/(A-AMO)                                               PLMPLT   129
      IF(LEVMO.EQ.0      ) OK=(RL-PRMO)/(PR-PRMO)                       PLMPLT   130
      IF(OK.LE.0.0) OK=0.0                                              PLMPLT   131
      IF(OK.GE.1.0) OK=1.0                                              PLMPLT   132
      STAT=STL+OK*(STA-STL)                                             PLMPLT   133
      IF(FL.GE.RCN) GO TO 1010                                          PLMPLT   134
         IF(PRMO.LT.RCN/1000.) GO TO 1010                               PLMPLT   135
         IF(PR.GT. RCN/100.) STPF=STL+PRMO*(STA-STL)/(PRMO-PR)          PLMPLT   136
         STAT = MIN1(STPF,STAT)                                         PLMPLT   137
 1010 KT=STAT/SCLK+1                                                    PLMPLT   138
      KS=MIN0(KS,120)                                                   PLMPLT   139
      KT=MIN0(KT,120)                                                   PLMPLT   140
      M=KMO                                                             PLMPLT   141
      N=KT                                                              PLMPLT   142
      LVL=LEVMO                                                         PLMPLT   143
C                                                                       PLMPLT   144
C  SET UP TO LOAD PRINT LINE                                            PLMPLT   145
 1011 CONTINUE                                                          PLMPLT   146
      IF(M.GT.120) GO TO 1101                                           PLMPLT   147
      DO 1100 K=M,N                                                     PLMPLT   148
      SYM(K+10)=DYM(LVL)                                                PLMPLT   149
      IF(LVL.GT.0      ) GO TO 1100                                     PLMPLT   150
      SYM(K+10)=1H*                                                     PLMPLT   151
      SYM(10)=1H*                                                       PLMPLT   152
 1100 CONTINUE                                                          PLMPLT   153
      IF(N.GE.KS) GO TO 1101                                            PLMPLT   154
      SYM(11+KT)=1H                                                     PLMPLT   155
      M=N+2                                                             PLMPLT   156
      N=KS                                                              PLMPLT   157
      LVL=LEV                                                           PLMPLT   158
      IF(M.LE.N) GO TO 1011                                             PLMPLT   159
C                                                                       PLMPLT   160
C        * REINITIALIZE K LOOP    *                                     PLMPLT   161
 1101 STL=STA                                                           PLMPLT   162
      KMO=KS+1                                                          PLMPLT   163
      LEVMO=LEV                                                         PLMPLT   164
      AMO=A                                                             PLMPLT   165
      PRMO=PR                                                           PLMPLT   166
 1110 CONTINUE                                                          PLMPLT   167
C        * CLOSE K LOOP    *                                            PLMPLT   168
C                                                                       PLMPLT   169
      OLR=FLOAT(LR)/(LCH-1)                                             PLMPLT   170
      OLT=INT(OLR)                                                      PLMPLT   171
      OLRT=ABS(OLR-OLT)                                                 PLMPLT   172
```

```
      IF(OLRT.GT.0.01) GO TO 0822                                       PLMPLT 173
      NRAD=QLT                                                          PLMPLT 174
      SYM(3)=LAB(NRAD)                                                  PLMPLT 175
      SYM(5)=1HP                                                        PLMPLT 176
      SYM(6)=1HA                                                        PLMPLT 177
      SYM(7)=1HD                                                        PLMPLT 178
      SYM(10)=1H-                                                       PLMPLT 179
      IF(NRAD.NE.1) GO TO 0820                                          PLMPLT 180
      SYM(3)=1H*                                                        PLMPLT 181
      SYM(10)=1H*                                                       PLMPLT 182
 0820 IF(NRAD.NE.0) GO TO 0822                                          PLMPLT 183
      SYM(3)=1HO                                                        PLMPLT 184
 0822 IF(OLR .LE.1.0)SYM(9)=1H*                                         PLMPLT 185
      PRINT FMP,SYM                                                     PLMPLT 186
 1111 CONTINUE                                                          PLMPLT 187
C  CLOSE L LOOP                                                         PLMPLT 188
C                                                                       PLMPLT 189
      LABN=1                                                            PLMPLT 190
      DKL=2.*RCN/SCLK                                                   PLMPLT 191
      IP=1                                                              PLMPLT 192
      IS=1                                                              PLMPLT 193
      IQ=11                                                             PLMPLT 194
 0202 LA=11                                                             PLMPLT 195
      LB=11                                                             PLMPLT 196
 0220 CONTINUE                                                          PLMPLT 197
      IF(IQ.GE.129) IQ=129                                              PLMPLT 198
      DO 0222 I=IS,IQ,2                                                 PLMPLT 199
      LAH=LAB(LA)                                                       PLMPLT 200
      LBH=LAB(LB)                                                       PLMPLT 201
      SYM(I)=LAH                                                        PLMPLT 202
 0222 SYM(I+1)=LBH                                                      PLMPLT 203
      IF(IQ.GE.129) GO TO 2200                                          PLMPLT 204
      GO TO (2000,2002,2020)IP                                          PLMPLT 205
C                                                                       PLMPLT 206
 2000 IS=IQ-1                                                           PLMPLT 207
      IP=2                                                              PLMPLT 208
      LBT=IABS(LB-5)-5                                                  PLMPLT 209
      IF(LBT.GE.0)LB=10                                                 PLMPLT 210
      GO TO 0220                                                        PLMPLT 211
C                                                                       PLMPLT 212
 2002 IS=IQ+1                                                           PLMPLT 213
      IQ=12+DKL*LABN                                                    PLMPLT 214
      IP=3                                                              PLMPLT 215
      GO TO 0202                                                        PLMPLT 216
C                                                                       PLMPLT 217
 2020 CONTINUE                                                          PLMPLT 218
      LB=LABN                                                           PLMPLT 219
      LABN=LABN+1                                                       PLMPLT 220
      IF(LABN.LE.10) GO TO 2000                                         PLMPLT 221
      LB=LB-10                                                          PLMPLT 222
      LA=1                                                              PLMPLT 223
 2022 IF(LB.LT.10) GO TO 2000                                           PLMPLT 224
      LA=LA+1                                                           PLMPLT 225
      LB=LB-10                                                          PLMPLT 226
      GO TO 2022                                                        PLMPLT 227
C                                                                       PLMPLT 228
 2200 PRINT FMP,SYM                                                     PLMPLT 229
```

```
      WRITE(6,0098)
      IF(IPLOT.GT.1)IPLOT=1                                               PLMPLT   230
      GO TO 0010                                                          PLMPLT   231
 0009 FORMAT(1H1/1H-/)                                                    PLMPLT   232
 0090 FORMAT(50X,*PLUME STATION (CORE NOZZLE DIAMETERS)*)                 PLMPLT   233
 0099 FORMAT(12X,*DISTRIBUTION OF *,A10,*IN EXHAUST PLUME*)               PLMPLT   234
 0900 FORMAT(17X,*CORE NOZZLE RADIUS = *,F6.4,* FEET*/)                   PLMPLT   235
 2202 CONTINUE                                                            PLMPLT   236
      DO 2222 K=1,49                                                      PLMPLT   237
      JE=NPD(K)                                                           PLMPLT   238
      DO 2220 J=1,JE                                                      PLMPLT   239
      P=PLM(5,J,K)                                                        PLMPLT   240
      P=(P-AINT(P))*1000.                                                 PLMPLT   241
 2220 PLM(5,J,K)=P                                                        PLMPLT   242
      RETURN                                                              PLMPLT   243
      END                                                                 PLMPLT   244
                                                                          PLMPLT   245
```

```
      OVERLAY(XRMP,6,0)                                                FILTER    2
      PROGRAM FILTER                                                   FILTER    3
      COMMON/FILTR/IFILTER,BFILTR(300)                                 FILTER    4
      COMMON/CHUCK/NT,NA,NFREQ,NU(300),NUFRST,NUINC,DNU(300)           FILTER    5
      COMMON/OBST/XTFA(36),AMI(5),AME(5),XTR(32)                       FILTER    6
      DIMENSION F(5,100),FR(100)                                       FILTER    7
      DIMENSION AST(5),AFN(5)                                          FILTER    8
      REAL NU,NUINC                                                    FILTER    9
      DATA(F(1,I),I=1,75)/3*0.,0.005,                                  FILTER   10
     *     0.01,0.02,0.03,0.155,0.28,0.50,0.72,                        FILTER   11
     *0.79,0.84,0.86,0.85,0.87,0.86,0.875,0.89,0.92,                   FILTER   12
     *0.95,0.94,0.93,0.915,0.90,0.95,1.0,0.765,0.53,0.335,             FILTER   13
     *0.14,0.135,0.07,0.06,0.05,0.04,0.03,0.03,0.03,                   FILTER   14
     *0.03,0.03,0.025,0.02,0.02,0.02,30*0./                            FILTER   15
      DATA(F(2,I),I=1,75)/                                             FILTER   16
     *38*0.,0.01,0.02,0.04,0.11,0.23,0.46,0.75,                        FILTER   17
     *0.92,1.0,1.0,0.99,0.92,0.87,0.84,0.63,                           FILTER   18
     *0.29,0.11,0.14,0.02,0.01,0.01,15*0./                             FILTER   19
      DATA(F(3,I),I=1,75)/                                             FILTER   20
     *39*0.,0.025,0.05,0.16,0.31,0.635,0.96,0.97,                      FILTER   21
     *0.98,0.99,0.98,0.99,1.0,0.99,0.98,0.95,0.94,                     FILTER   22
     *0.925,0.91,0.70,0.49,0.355,0.22,0.14,0.06,                       FILTER   23
     *0.0525,0.07,0.05,0.03,0.015,7*0./                                FILTER   24
      DATA(F(4,I),I=1,75)/                                             FILTER   25
     *19*0.,0.105,0.21,0.425,0.64,0.73,0.82,0.83,                      FILTER   26
     *0.84,0.835,0.83,0.825,0.82,0.82,0.82,0.845,                      FILTER   27
     *0.87,0.88,0.89,0.855,0.84,0.89,0.94,0.97,1.0,                    FILTER   28
     *0.995,0.99,0.97,0.95,0.94,0.93,0.91,0.89,                        FILTER   29
     *0.855,0.82,0.78,0.74,0.695,0.65,0.525,0.40,                      FILTER   30
     *15*0./                                                           FILTER   31
      DATA(F(5,I),I=1,75)/                                             FILTER   32
     *15*0.,0.01,0.02,0.035,0.15,0.48,0.81,0.81,                       FILTER   33
     *0.81,0.865,0.92,0.955,0.99,0.995,1.0,                            FILTER   34
     *0.945,0.89,0.93,0.97,0.965,0.98,0.89,0.82,                       FILTER   35
     *0.805,0.79,0.605,0.42,0.255,0.09,0.07,                           FILTER   36
     *0.05,0.045,0.04,0.025,0.01,0.005,25*0./                          FILTER   37
      DATA AST/1.9,3.75,3.4,2.6,2.5/                                   FILTER   38
      DATA AFN/4.1,4.85,5.6,4.8,4.7/                                   FILTER   39
      NAMELIST/FILT/ASTART,FR                                          FILTER   40
      ASTART=1.9                                                       FILTER   41
      IF(IFILTER.GT.0) GO TO 400                                       FILTER   42
      READ(5,FILT)                                                     FILTER   43
        WRITE(6,FILT)                                                  FILTER   44
      IFILTER=1                                                        FILTER   45
      NX=(AME(1)-AMI(1))/0.05+1.01                                     FILTER   46
      DO 401 I=1,NX                                                    FILTER   47
  401 F(1,I)=FR(I)                                                     FILTER   48
  400 CONTINUE                                                         FILTER   49
      AMI( )=AST(IFILTER)                                              FILTER   50
      AME(1)=AFN(IFILTER)                                              FILTER   51
C                                                                      FILTER   52
C  SETTUP NU AND DNU FOR WAVELENGTH OF CALCULATION (MIK)               FILTER   53
C                                                                      FILTER   54
      NEND=1.0E+4/AMI(1)                                               FILTER   55
      NBEG=1.0E+4/AME(1)                                               FILTER   56
      XUC=NBEG                                                         FILTER   57
      IF(NUINC.GT.0.) GO TO 42                                         FILTER   58
```

```
C                                                                       FILTER  59
C     INCREMENTS BASED ON MAXIMUM RESOLUTION OF DATA INCLUDED IN        FILTER  60
C     THE UNIVERSITY OF MICHIGAN PLUMES PROGRAM                         FILTER  61
C                                                                       FILTER  62
      I=1                                                               FILTER  63
      DN=25.                                                            FILTER  64
      IF(XUC.LT.2000.) GO TO 602                                        FILTER  65
      IF(XUC.GT.2400..AND.XUC.LT.3080.) GO TO 602                       FILTER  66
      IF(XUC.GT.3770.) GO TO 602                                        FILTER  67
      DN=10.                                                            FILTER  68
  602 NWB=INT(2.*WBEG/DN)+1                                             FILTER  69
      XUC=FLOAT(NWB)*DN/2.                                              FILTER  70
C                                                                       FILTER  71
C     DNU(IK,1)=XUC-WBEG+DN/2.                                          FILTER  72
C     NU(IK,1)=XUC                                                      FILTER  73
C                                                                       FILTER  74
C     DO THE SAME FOR ALL NU AND DNU CARDS IF MULTIPLE WAVELENGTHS TO   FILTER  75
C     BE UTILIZED                                                       FILTER  76
C                                                                       FILTER  77
      DNU(1)=XUC-WBEG+DN/2.                                             FILTER  78
      NU(1)=XUC                                                         FILTER  79
      DNA=DN                                                            FILTER  80
      GO TO 41                                                          FILTER  81
   40 I=I+1                                                             FILTER  82
      DNU(I)=DN                                                         FILTER  83
      NU(I)=XUC                                                         FILTER  84
   41 XUC=XUC+DNA/2.                                                    FILTER  85
      DN=25.                                                            FILTER  86
      IF(XUC.LT.2000.) GO TO 601                                        FILTER  87
      IF(XUC.GT.2400..AND.XUC.LT.3080.) GO TO 601                       FILTER  88
      IF(XUC.GT.3770.) GO TO 601                                        FILTER  89
      DN=10.                                                            FILTER  90
  601 XUC=XUC+DN/2.                                                     FILTER  91
      DNA=DN                                                            FILTER  92
      IF(XUC.LT.WEND) GO TO 40                                          FILTER  93
      NFREQ=I                                                           FILTER  94
      DNU(I)=WEND-NU(I-1)-0.5*DNU(I-1)                                  FILTER  95
      GO TO 58                                                          FILTER  96
C                                                                       FILTER  97
C     INCREMENTS AND FREQUENCY CENTERS BASED ON NUINC (DEFAULT=50CM-1)  FILTER  98
C                                                                       FILTER  99
   42 NFREQ=INT((WEND-WBEG)/NUINC)+1                                    FILTER 100
      XUC=XUC+NUINC/2.                                                  FILTER 101
      DO 43 I=1,NFREQ                                                   FILTER 102
      NU(I)=XUC                                                         FILTER 103
      DNU(I)=NUINC                                                      FILTER 104
   43 XUC=XUC+NUINC                                                     FILTER 105
   44 DNU(NFREQ)=WEND-NU(NFREQ)+NUINC/2.                                FILTER 106
   58 CONTINUE                                                          FILTER 107
      NUFRST=1                                                          FILTER 108
      GO TO (11,12,13,14,15) IFILTER                                    FILTER 109
C     BAND ONE                                                          FILTER 110
   11   INDEX=0                                                         FILTER 111
        GO TO 15                                                        FILTER 112
C     BAND TWO                                                          FILTER 113
   12   INDEX=37                                                        FILTER 114
        GO TO 16                                                        FILTER 115
```

```
C  BAND THREE                                                        FILTER  116
13    INDEX=30                                                       FILTER  117
      GO TO 16                                                       FILTER  118
C  BAND FOUR                                                         FILTER  119
14    INDEX=14                                                       FILTER  120
      GO TO 16                                                       FILTER  121
C  BAND FIVE                                                         FILTER  122
15    INDEX=12                                                       FILTER  123
16    DO 17 II=1,NFREQ                                               FILTER  124
      FCHK=10000./MU(II)                                             FILTER  125
      IK=INT((FCHK-AMI(1) )/0.05+1.01) + INDEX                       FILTER  126
      AL=ASTART+0.05*FLOAT(IK-1)                                     FILTER  127
      FRAC=(FCHK-AL)/0.35                                            FILTER  128
17    RFILTR(II)=F(IFILTER,IK)+FRAC*(F(IFILTER,IK+1)-F(IFILTER,IK))  FILTER  129
      END                                                            FILTER  130
```

```
      OVERLAY(XRMP,7,0)                                                  XPLOT   2
      PROGRAM XPLOT                                                      XPLOT   3
      DIMENSION RANGE(5),RAR(200),ROD(200),ROZ(200),SIG(4,200)           XPLOT   4
      DIMENSION A(4)                                                     XPLOT   5
      COMMON/SPATIAL/ISPAT                                               XPLOT   6
      IF(ISPAT.GT.2) GO TO 300                                           XPLOT   7
      REWIND 8                                                           XPLOT   8
      READ(8) NRANG                                                      XPLOT   9
      READ (8) (RANGE(I),I=1,NRANG)                                      XPLOT  10
      READ (8) R8,RENO,XC,AL,RCOR                                        XPLOT  11
      READ (8) K                                                         XPLOT  12
      DO 18 I=1,K                                                        XPLOT  13
   18 READ(8) RAR(I),ROD(I),ROZ(I)                                       XPLOT  14
      NK=2*NRANG                                                         XPLOT  15
      DO 9 I=1,K                                                         XPLOT  16
      DO 9 J=1,NK                                                        XPLOT  17
    9 READ (8) SIG(J,I)                                                  XPLOT  18
      WRITE(6,10) NRANG,R8,RENO,XC,AL,RCOR,K                             XPLOT  19
      WRITE(6,21) (RANGE(I),I=1,NRANG)                                   XPLOT  20
   21 FORMAT(1X,2F10.1)                                                  XPLOT  21
   10 FORMAT(1X,I2,5F13.4,I3)                                            XPLOT  22
      DO 11 I=1,K                                                        XPLOT  23
      DO 11 J=1,NK                                                       XPLOT  24
   11 SIG(J,I)=SIG(J,I)/RAR(I)                                           XPLOT  25
      DO 12 I=1,K                                                        XPLOT  26
   12 WRITE(6,13) RAR(I),ROD(I),ROZ(I),(SIG(J,I),J=1,NK)                 XPLOT  27
   13 FORMAT(1X,7E14.7)                                                  XPLOT  28
      DO 20 J=1,NK                                                       XPLOT  29
   20 A(J)=0.                                                            XPLOT  30
      DO 19 I=1,K                                                        XPLOT  31
      DO 19 J=1,NK                                                       XPLOT  32
   19 A(J)=SIG(J,I)*RAR(I)+A(J)                                          XPLOT  33
      WRITE(6,13) (A(J),J=1,NK)                                          XPLOT  34
      IF(ISPAT.LT.2) GO TO 300                                           XPLOT  35
      PUNCH 10 ,  NRANG,R8,RENO,XC,AL,RCOR,K                             XPLOT  36
      PUNCH 21 ,  (RANGE(I),I=1,NRANG)                                   XPLOT  37
      DO 220 I=1,K                                                       XPLOT  38
  220 PUNCH 13 ,  RAR(I),ROD(I),ROZ(I),(SIG(J,I),J=1,NK)                 XPLOT  39
  300 CONTINUE                                                           XPLOT  40
      END                                                                XPLOT  41
```

```
      OVERLAY(XRHP,11,0)                                                RIMAINS   2
      PROGRAM REMAIN                                                    RIMAINS   3
      COMMON /HTPACK/ IHT(80),HTARY(80),IHTS                            RIMAINS   4
      COMMON /CPPCPG/ CPP                                               RIMAINS   5
      COMMON /CONFLM/ NBMOVE,K5(2,20),REN1(21),HXP1(2,20),F1(21),NM1,   RIMAINS   6
     *   HXT,AF,SVHK,HD                                                 RIMAINS   7
      COMMON /NODEN1/ NODEF1(2,20),       S(2,20)                       RIMAINS   8
      COMMON /OPPER/ TS(2),UA(2),K12(2),N12(2),PTSC(2),TTSC(2),RSC(2),  RIMAINS   9
     *        K23(2),N23(2),WSET(2),CPSC(2),GAMASC(2),CDX(2),PORS(2)    RIMAINS  10
      COMMON /SHIFT/ SHIFT(14),IN,MAMOVE,NUMOVE,KOOLSF                  RIMAINS  11
      DIMENSION X1( 1),Y1( 1),X2( 1),Y2( 1),                            RIMAINS  12
     1     KA(50),AREAM(50),          NZ(5),     NODEM(50),NODEF(50),K(5)  RIMAINS  13
      DIMENSION XXX(2,100),XXP(2,100),AACT(5),    XXRT(2,100),XXDEN(2,100  RIMAINS  14
     1),XXY(2,100),XXHT(2,100),NHD(5),INDIC(2),IND(2),MA(2),NB(2),NUM(2)  RIMAINS  15
      COMMON /KOOL/KOOL(5)                                              RIMAINS  16
      DIMENSION NODEN2(5,20),XX2(5,20),KIK(5,20),NNA(5),IABC(2)         RIMAINS  17
      REAL          K12,N12,K23,N23,K5                                  RIMAINS  18
      COMMON/PLM/ 23(5000)                                              RIMAINS  19
      COMMON/AA/ NODE1(50),HT1(50),LU                                   RIMAINS  20
      COMMON/BB/ NODEN3(30),TP1A(30),NNAT                               RIMAINS  21
      COMMON/CC/ NODEN(10),HT1(10),LUU,KOOLT                            RIMAINS  22
      COMMON/BBB/ NODE15(50),FT1(50),LU1                                RIMAINS  23
      COMMON/CCC/ FS(2)                                                 RIMAINS  24
      EQUIVALENCE (O     (1),X1(1)), (OB(4056),Y1(1)), (OB(4111),X2(1)),  RIMAINS  25
     *     (OB(4165),Y2(1))                                             RIMAINS  26
      COMMON XL(100),ACROSS(80),                                        RIMAINS  27
     1YL1( 80),YL2( 80),PP(150),AA(150),XMM1(150),XMM2(150),TRS(150),   RIMAINS  28
     2DENP1(150),VPP(150),TPP(150),DENS1(150),VSS(150),PT(100),         RIMAINS  29
     3XMST( 80),TST( 80),DENST( 80),VST( 80),XMPT( 80),TPT(100),        RIMAINS  30
     4DENPT(100),VPT(1,2),L,LL                                          RIMAINS  31
      COMMON/ALL/ N,NN,NSN,ISURF(50),NODE(55),JSURF(5,2),XF(5),NTOT1,   RIMAINS  32
     *              NOP,NP(10), AREA(80)                                RIMAINS  33
      COMMON /LINKS/ HI11(100), YN(2,20), YN(2,20), LX(2,20), IW, IARC  RIMAINS  34
      COMMON /PRINT/ PRINT1, PRINT2, PRINT3, PRINT4, PRINT5,            RIMAINS  35
     *              PRINT6, PRINT7, PRINT8, PRINT9, PRINT0              RIMAINS  36
      COMMON /HOT/ AT,CF11(80),CHIA(5),CTHIA(5),FFT,FPAT,HGAI,HIA(5,2), RIMAINS  37
     1ICS,ICSURF(5),II,IKJ,ISTREM(5),KK(5),KSURF(5),NODEN(5,20),NJ,N2,  RIMAINS  38
     2PTP,PTS,THETA(5,2),TTP,TTS,XF1,XI(5),XU1(20),XU2(20),X11(80),     RIMAINS  39
     3YU1(20),YU2(20),Y11(80),I,KA(5,2)                                 RIMAINS  40
      COMMON/EXIT/ RSN,RPN,PFL,XP,ANL,RTE                               RIMAINS  41
      INTEGER PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8   RIMAINS  42
     1,PRINT9,PRINT0                                                    RIMAINS  43
      IHTS=0                                                            RIMAINS  44
      LU1=0                                                             RIMAINS  45
      KHX=0                                                             RIMAINS  46
    1 FORMAT(2X,5I2)                                                    RIMAINS  47
    5 FORMAT(2X,3I2,2X,2F10.5)                                          RIMAINS  48
  609 FORMAT(2X,2I2,4X,2F10.5)                                          RIMAINS  49
      LUU=0                                                             RIMAINS  50
      KOOLT=0                                                           RIMAINS  51
      DO 605 I=1,NNN                                                    RIMAINS  52
      READ(5,1) KSURF(I),NZ(I),KOOL(I)                                  RIMAINS  53
      NAU=NZ(I)                                                         RIMAINS  54
      READ(5,685) (NODEN(I,J),J=1,NAU)                                  RIMAINS  55
  605 CONTINUE                                                          RIMAINS  56
  685 FORMAT(2X,35I2)                                                   RIMAINS  57
      IH=0                                                              RIMAINS  58
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```
      IABC(1)=0                                                         RIMAINS   59
      IABC(2)=0                                                         RIMAINS   60
      DO 12 J=1,NN                                                      RIMAINS   61
      READ(5,5) ISTREM(J),K(J),KK(J),XI(J),XF(J)                        RIMAINS   62
      IF(KK(J) .EQ. 0) GO TO 937                                        RIMAINS   63
      READ(5,4) AACI(J)                                                 RIMAINS   64
  937 READ(5,1) NNA(J)                                                  RIMAINS   65
      NU=NNA(J)                                                         RIMAINS   66
      READ(5,607) (NODEN2(J,I),KIK(J,I),XX2(J,I),I=1,NU)                RIMAINS   67
  607 FORMAT(2X,2I2,4X,F10.5)                                           RIMAIN    68
      DO 41 II=1,2                                                      RIMAINS   69
      READ(5,606) JSURF(J,II),KA(J,II),THETA(J,II),HTA(J,II)            RIMAINS   70
      DO 41 IIIA=1,NNN                                                  RIMAINS   71
      IF(JSURF(J,II) .EQ. KSURF(IIIA)) GO TO 45                         RIMAINS   72
   41 CONTINUE                                                          RIMAINS   73
   45 IF(KOOL(IIIA) .GT. 0) GO TO 42                                    RIMAINS   74
      GO TO 40                                                          RIMAINS   75
   42 DO 631 IAB=1,2                                                    RIMAINS   76
      IF(IABC(IAB) .EQ. JSURF(J,II)) GO TO 40                           RIMAINS   77
  631 CONTINUE                                                          RIMAINS   78
  901 IW=IW+1                                                           RIMAINS   79
      IABC(IW)= JSURF(J,II)                                             RIMAINS   80
      READ(5,4) TTSC(IW),RSC(IW),GAMASC(IW),CPSC(IW),WSET(IW),TS(IW),   RIMAINS   81
     1UA(IW)                                                            RIMAINS   82
      IF(WSET(IW) .NE. 0.0) GO TO 3000                                  RIMAINS   83
      READ(5,4) PTSC(IW),K12(IW),N12(IW)                                RIMAINS   84
 3000 IF(KOOL(IIIA) -2) 902,903,904                                     RIMAINS   85
  902 READ(5,4) K23(IW),N23(IW),FORS(IW)                                RIMAINS   86
      READ(5,1) MA(IW)                                                  RIMAINS   87
      MAA=MA(IW)                                                        RIMAINS   88
      READ(5,606) (LX(IW,JA),JA=1,MAA)                                  RIMAINS   89
      MAA=MAA+1                                                         RIMAINS   90
      READ(5,4)(XN(IW,JA),YN(IW,JA),JA=1,MAA)                           RIMAINS   91
      GO TO 40                                                          RIMAINS   92
  903 READ(5,1) NUM(IW),MA(IW)                                          RIMAINS   93
      KAA=MA(IW)                                                        RIMAINS   94
      READ(5,606)(NODEN1(IW,JA),JA=1,MAA)                               RIMAINS   95
      READ(5,606) LX(IW,JA),JA=1,MAA)                                   RIMAINS   96
      NUM1=NUM(I )                                                      RIMAINS   97
      READ(5,4)(S(IW,JA),JA=1,NUM1)                                     RIMAINS   98
      NUM1=NUM1+1                                                       RIMAINS   99
      READ(5,4)(XN(IW,JA),YN(IW,JA),JA=1,NUM1)                          RIMAINS  100
      READ(5,4)COX(IW)                                                  RIMAINS  101
      GO TO 40                                                          RIMAINS  102
  904 READ(5,1) NUM(IW),N3(IW),MA(IW)                                   RIMAINS  103
      JA=N3(IW)+1                                                       RIMAINS  104
      READ(5,98)(XN(IW,I),YN(IW,I),S(IW,I),K5(IW,I),I=1,JA)             RIMAINS  105
   98 FORMAT(4F10.5)                                                    RIMAINS  106
      JB=MA(IW)                                                         RIMAINS  107
      READ(5,605)(NODEN1(IW,I),I=1,JB)                                  RIMAINS  108
      READ(5,606)(LX(IW,I),I=1,JB)                                      RIMAINS  109
      IF(KHX .EQ. 1) GO TO 40                                           RIMAINS  110
      KHX=1                                                             RIMAINS  111
      READ(5,1) NN1                                                     RIMAINS  112
      READ(5,99)(        REN1(I),HXP1(I),F1(I),I=1,NN1)                 RIMAINS  113
      READ(5,4 ) WXT,AR,SVHX,HD                                         RIMAINS  114
   99 FORMAT(3F10.5)                                                    RIMAINS  115
```

```
   40 CONTINUE
   10 CONTINUE
      NNAT=0
      DO 11 I=1,NN
   11 NNAT=NNAT+NNA(I)
      READ(5,1) ICS
      IF(ICS) 501,501,502
  502 READ(5,500) (ICSURF(JJA),JJA=1,ICS)
  500 FORMAT(2X,5I2)
  501 READ(5,4) PTP,TTP,RP,GAMMAP,WP
      READ(5,4) PTS,TTS,RS,GAMMAS,WS
      READ(5,4) PAMB
    4 FORMAT(8F12.5)
      DO 700 I=1,NNN
      HSAT=0.0
      AT=0.0
      FPAT=0.0
      FFT=0.0
      CALL STORE(HSAT,AT,I,0)
      CALL STORE1(FPAT,FFT,I,0)
  700 CONTINUE
      IH=0
      DO 800 JUU=1,ICS
  800 NHU(JUU)=0
      LL1=0
      READ(5,606)(NODEM(I),NODEF(I),I=1,NTOT1)
      DO 15 I=1,NN
      READ(5,1) IA
      IF(IA) 17,17,16
   16 READ(5,7) (YA(J),AREAM(J),J=1,IA)
    7 FORMAT(8F10.2)
   17 CALL ARRAY(X1,Y1,X2,Y2,YF,NOP,I,ISURF,JSURF,XU1,YU1,XU2,YU2,N1,
     1N2,KK(I))
      CALL AXAREA(XI(I),YF(I),YA,AREAM,IA,N1,N2,XU1,YU1,XU2,YU2)
      IF(K(I)-1) 20,21,22
   20 PTP1=PTS
      TTP1=TTS
      GAMMP1=GAMMAS
      RP1=RS
      WS1=WS/2.
      WP1=WS1
      CALL COFLOW(PTP1,PTS,TTP1,TTS,GAMMP1,GAMMAS,RP1,RS,WP1,WS1,PAMB,
     1AACT(I),KK(I))
      GO TO 23
   21 PTS1=PTP
      TTS1=TTP
      GAMMS1=GAMMAP
      RS1=RP
      WP1=WP/2.
      WS1=WP1
      CALL COFLOW(PTP,PTS1,TTP,TTS1,GAMMAP,GAMMS1,RP,RS1,WP1,WS1,PAMB,
     1AACT(I),KK(I))
      GO TO 23
   22 CALL COFLOW(PTP,PTS,TTP,TTS,GAMMAP,GAMMAS,RP,RS,WP,WS,PAMB,
     1AACT(I),KK(I))
   23 DO 25 J=1,LL
      CALL PENDTL(TRP(J),PKP)
```

```
      CALL PRNOTL(TRS(J),PNS)
      RRRF=PNP**(0.333)
      RRRS=PNS**(.333)
      GRP=(GAMMAP-1.)/2.
      GRS=(GAMMAS-1.)/2.
      TRS(J)=TRS(J)*(1.+(RPRS*GRS*XMM2(J)*XMM2(J)))
   25 TRP(J)=TRP(J)*(1.+(RRRP*GRP*XMM1(J)*XMM1(J)))
      CALL GATHER(ACROSS,K(I),L)
      IF(PRINT1 .EQ. 0) GO TO 2003
      WRITE(6,105) ISTREM(I)
  105 FORMAT(1H1,//23X,16HFLOW STREAM NO. ,I1,17H FLOW INFORMATION,//)
 2010 IF(K(I)-1) 100,200,300
  100 IF(PRINT1 .EQ. 0) GO TO 400
      WRITE(6,106)
  106 FORMAT(     90H  AXIAL      OUTER      INNER        FLOW      STATIC
     1SECOND.   SECOND.   SECOND.   SECOND. ,/90H DISTANCE  SURF DIS  SU
     2RF DIS     AREA      PRESS      MACH NO  REC TEMP  VELOCITY   DENSITY
     3 ,/90H (INCHES)  (INCHES)  (INCHES)    (SQIN)    (LB/SQIN)
     4 (DEG R.)  (FT/SEC)  (LB/CUFT),/)
      LINE=9
      DO 110 J=1,L
      IF(LINE-58) 111,111,112
  112 WRITE(6,107)
  107 FORMAT(1H1,//)
      WRITE(6,106)
      LINE=7
  111 WRITE(6,108) XL(J),YL1(J),YL2(J),ACROSS(J),PT(J),XMST(J),TST(J),VS
     1T(J),DENST(J)
  108 FORMAT(2X,F6.2,2X,2(2X,F5.2,3X),2X,F7.2,3X,F5.2,5X,F6.4,2X,2(2X,F7
     1.2,1X),2X,F6.4,/)
      LINE=LINE+2
  110 CONTINUE
      GO TO 400
  200 IF(PRINT1 .EQ. 0) GO TO 2002
      WRITE(6,206)
  206 FORMAT(     90H  AXIAL      OUTER      INNER        FLOW      STATIC
     1PRIMARY    PRIMARY   PRIMARY   PRIMARY ,/90H DISTANCE  SURF DIS  SU
     2RF DIS     AREA      PRESS      MACH NO  REC TEMP  VELOCITY   DENSITY
     3 ,/90H (INCHES)  (INCHES)  (INCHES)    (SQIN)    (LB/SQIN)
     4 (DEG R.)  (FT/SEC)  (LB/CUFT),/)
      LINE=9
      DO 210 J=1,L
      IF(LINE-58) 211,211,212
  212 WRITE(6,107)
      WRITE(6,206)
      LINE=7
  211 WRITE(6,108) XL(J),YL1(J),YL2(J),ACROSS(J),PT(J),XMPT(J),TPT(J),VP
     1T(J),DENPT(J)
      LINE=LINE+2
  210 CONTINUE
 2002 IF(XI(I) .EQ. 0.0) GO TO 1041
      GO TO 400
  300 IF(PRINT1 .EQ. 0) GO TO 2003
      WRITE(6,306)
  306 FORMAT(      130H  AXIAL      OUTER      INNER        FLOW      STATIC
     1 PRIMARY   SECOND.   PRIMARY   SECOND.   PRIMARY   SECOND.   PRIMA
     2RY   SECOND. ,/130H DISTANCE  SURF DIS  SURF DIS    AREA       PRESS
```

```
     3      MACH NO   MACH NO  REC TEMP  REC TEMP  VELOCITY  VELOCITY    D
     4ENSITY   DENSITY ,/130H (INCHES)  (INCHES)  (INCHES)    (SQIN)    (L
     5B/SQIN)                    (DEG R.)  (DEG R.)  (FT/SEC)  (FT/SEC)
     6  (LB/CUFT) (LB/CUFT),/)
      LINE=9
      DO 310 J=1,L
      IF(LINE-58) 311,311,312
  312 WRITE(6,107)
      WRITE(6,306)
      LINE=7
  311 WRITE(6,308) XL(J),YL1(J),YL2(J),ACROSS(J),PT(J),XMPT(J),XMST(J),T
     1PT(J),TST(J),VPT(J),VST(J),DENPT(J),DENST(J)
  308 FORMAT(2X,F6.2,2X,2(2X,F5.2,3X),2X,F7.2,3X,F5.2,3X,2(2X,F6.4,2X),4
     1(2X,F7.2,1X),2(2X,F6.4,2X),/)
      LINE=LINE+2
  310 CONTINUE
 2003 IF(XI(I) .NE. 0.0) GO TO 400
 1041 CALL CPASMA(XMPT(1),TTP,CPP,GAMMAP)
  438 CALL ARRAY(X1,Y1,X2,Y2,XF,NOF,I,ISURF,JSURF,XJ1,YU1,XU2,YU2,
     1N1,N2,KK(I))
      IF(I.EQ.NN) WRITE(6,2004) RSN,RFN,RPL,XP,AHL,RTE
 2004 FORMAT(*0    RADIUS SECOND. NOZZLE*F8.3,* INCHES*/*    RADIUS PRIMA
     1RY NOZZLE*F8.3,* INCHES*/*     RADIUS PLUG*F8.3,* INCHES*/*    LENG
     2TH PLUG*F8.3,* INCHES*/*    NOZZLE LENGTH*F8.2* INCHES*/
     3 *     TURBINE RADIUS*F8.3* INCHES*)
      IF(XU2(N2) .LE. XF(I)) GO TO 403
      IF(KK(I) .EQ. 0) GO TO 401
      DIFF=XU2(N2)-XF(I)
      I23=L+DIFF+1
      I24=L+1
      DO 408 II=I24,I23
      XL(II)=XF(I)+II-L
      IF(II .EQ. I23) GO TO 409
      DO 407 I25=1,N2
      IF(XU2(I25) .GT. XL(II)) GO TO 404
  407 CONTINUE
  409 XL(II)=XU2(N2)
      YL2(II)=YU2(N2)
      GO TO 405
  404 YL2(II)=STRATE(XU2(I25-1),XU2(I25),YU2(I25-1),YU2(I25),X (II))
  405 PT(II)=PT(L)
      XMPT(II)=XMPT(L)
      XMST(II)=XMST(L)
      TPT(II)=TPT(L)
      TST(II)=TST(L)
      VPT(II)=VPT(L)
      VST(II)=VST(L)
      DENST(II)=DENST(L)
  408 DENPT(II)=DENPT(L)
  403 XF1=XU2(N2)
      GO TO 402
  401 XF1=XF(I)
  402 DO 33 II=1,2
      CALL OVERLAY(4HXRHP,9,5,6HRECALL)
C     CALL HOTPT
  850 DO 958 I9=1,LU
      DO 951 I8=1,NTOT1
```

```
      IF(NODE1(I9) .EQ. NODEM(I8)) GO TO 952
  951 CONTINUE
      WRITE(6,1001) NODE1(I9)
 1001 FORMAT("0***** CHECK INPUT FOR NODE"I4)
      I8=NTOT1
  952 IHTS=IHTS+1
      IHT(IHTS)=NODE1(I9)*100+NODEF(I8)
      HTARY(IHTS)=HT1(I9)
  950 CONTINUE
      DO 750 KUU=1,NNN
      IF(JSURF(I,II) .EQ. KSURF(KUU)) GO TO 751
  750 CONTINUE
      GO TO 30
  751 IF(KOOL(KUU) .GT. 0) GO TO 752
      GO TO 30
  752 DO 753 JUU=1,ICS
      IF(KSURF(KUU) .EQ. ICSURF(JUU)) GO TO 755
  753 CONTINUE
      IW=IW+1
      INDIC(IW)=KSURF(KUU)
      DO 756 IWW=1,L
      XXX(IW,IWW)=XL(IWW)
      XXP(IW,IWW)=PT(IWW)
      XXRT(IW,IWW)=TPT(IWW)
      XXV(IW,IWW)=VPT(IWW)
      XXHT(IW,IWW)=HT11(IWW)
  756 XXDEN(IW,IWW)=DENPT(IWW)
      IND(IW)=L
      GO TO 30
  755 IF(NWD(JUU) .GT. 0) GO TO 818
      IW=IW+1
      INDIC(IW)=KSURF(KUU)
      DO 758 IWW=1,L
      XXX(IW,IWW)=XL(IWW)
      XXP(IW,IWW)=PT(IWW)
      XXRT(IW,IWW)=TPT(IWW)
      XXV(IW,IWW)=VPT(IWW)
      XXHT(IW,IWW)=HT11(IWW)
  758 XXDEN(IW,IWW)=DENPT(IWW)
      IND(IW)=L
      NWD(JUU)=L-1
      GO TO 30
  818 DO 820 IW=1,2
      IF(KSURF(KUU) .EQ. INDIC(IW)) GO TO 821
  820 CONTINUE
  821 IO=NWD(JUU)+1
      IO1=1
      LJ=L+IO-1
      DO 830 IWW=IO,LJ
      XXX(IW,IWW)=XL(IO1)
      XXP(IW,IWW)=PT(IO1)
      XXRT(IW,IWW)=TPT(IO1)
      XXV(IW,IWW)=VPT(IO1)
      XXHT(IW,IWW)=HT11(IO1)
      XXDEN(IW,IWW)=DENPT(IO1)
  830 IO1=IO1+1
      IND(IW)=LJ
```

```
      NWO(JUU)=LJ-1                                                     RIMAINS  344
   33 CONTINUE                                                          RIMAINS  345
      IF(PRINT4 .GT. 0) WRITE(6,860)                                    RIMAINS  346
      NU=NNA(I)                                                         RIMAINS  347
      LINEFL=4                                                          RIMAINS  348
      DO 856 IM=1,NU                                                    RIMAINS  349
      IF(K(I)-1) 851,852,853                                            RIMAINS  350
  853 IF(KIK(I,IM) .EQ. 1) GO TO 852                                    RIMAINS  351
  851 CALL TABLEL(XL,TST,XX2(I,IM),TR11,DUM,L)                          RIMAINS  352
      GO TO 855                                                         RIMAINS  353
  852 CALL TABLEL(XL,TPT,XX2(I,IM),TR11,DUM,L)                          RIMAINS  354
  855 IF(PRINT4 .EQ. 0) GO TO 962                                       RIMAINS  355
      IF(LINEFL .LE. 58) GO TO 961                                      RIMAINS  356
      WRITE(6,460)                                                      RIMAINS  357
      LINEFL=4                                                          RIMAINS  358
  961 WRITE(6,461) NODEN2(I,IM),TR11                                    RIMAINS  359
      LINEFL=LINEFL+3                                                   RIMAINS  360
  962 LL1=LL1+1                                                         RIMAINS  361
      NODENJ(LL1)=NODEN2(I,IM)                                          RIMAINS  362
      TR1A(LL1)=TR11-460.0                                              RIMAINS  363
  855 CONTINUE                                                          RIMAINS  364
  860 FORMAT(1H1,28X,"FLUID LUMP TEMPERATURES",//)                      RIMAINS  365
  861 FORMAT(35X,"NODE NO. ",I2,/26X,"TEMPERATURE=",F7.2," DEG. R.",/)  RIMAINS  366
   15 CONTINUE                                                          RIMAINS  367
      IN=IND(IW)                                                        RIMAINS  368
      JABC=0                                                            RIMAINS  369
      IW=0                                                              RIMAINS  370
      DO 1009 J=1,NN                                                    RIMAINS  371
      DO 1010 II=1,2                                                    RIMAINS  372
      DO 1011 IAB=1,NNN                                                 RIMAINS  373
      IF(JSURF(J,II) .EQ. KSURF(IAB)) GO TO 1015                        RIMAINS  374
 1011 CONTINUE                                                          RIMAINS  375
 1015 IF(JSURF(J,II) .NE. JABC) GO TO 1018                              RIMAINS  376
      GO TO 1010                                                        RIMAINS  377
 1018 IF(KOOL(IAB) .GT. 0) GO TO 1016                                   RIMAINS  378
      GO TO 1010                                                        RIMAINS  379
 1016 IW=IW+1                                                           RIMAINS  380
      JABC=JSURF(J,II)                                                  RIMAINS  381
      IN=IND(IW)                                                        RIMAINS  382
      INMOVE=IW                                                         RIMAINS  383
      DO 1234 ISF=1,14                                                  RIMAINS  384
      SHIFT(ISF)=TS(INMOVE)                                             RIMAINS  385
 1234 INMOVE=INMOVE+2                                                   RIMAINS  386
      MAMOVE=MA(IW)                                                     RIMAINS  387
      NUMOVE=NUM(IW)                                                    RIMAINS  388
      NBMOVE=NB(IW)                                                     RIMAINS  389
      KOOLSF=KOOL(IAB)                                                  RIMAINS  390
      DO 1060 JEW=1,IW                                                  RIMAINS  391
      XL(JEW)=XXX(IW,JEW)                                               RIMAINS  392
      PT(JEW)=XXP(IW,JEW)                                               RIMAINS  393
      TPT(JEW)=XXPT(IW,JEW)                                             RIMAINS  394
      VPT(JEW)=XXV(IW,JEW)                                              RIMAINS  395
      HT11(JEW)=XXHT(IW,JEW)                                            RIMAINS  396
 1060 DENPT(JEW)=XXDEN(IW,JEW)                                          RIMAINS  397
      IF(KOOL(IAB)-2) 1012,1013,1014                                    RIMAINS  398
 1012 CALL OVERLAY(4HXXHP,9,1,6HRECALL)                                 RIMAINS  399
C1012 CALL TPANEL                                                        RIMAINS  400
```

```
      GO TO 2810
 1012 CALL OVERLAY(4HXRMP,9,2,6HRECALL)
C1013 CALL FILMCL
      GO TO 2810
 1014 CALL OVERLAY(4HXRMP,9,3,6HRECALL)
C1014 CALL CONFLM
 2810 KOOLT=KOOLT+KOOL(IAB)
 1010 CONTINUE
 1039 CONTINUE
      IF(PRINTO .EQ. 0) GO TO 10000
      CALL OVERLAY(4HXRMP,9,4)
C     CALL CALFDP
10000 CONTINUE
      END
```

```
      SUBROUTINE AVER(A,TW,LX,NODE,M,IW,PRINTS)                         AVER   2
      DIMENSION A(1),TW(1),LX(1),NODE(2,10)                             AVER   3
      COMMON/CC/ NODEN4(10),WT1(10),LUU,KOOLT                           AVER   4
      INTEGER PRINTS                                                    AVER   5
      KK=1                                                              AVER   6
      K=0                                                               AVER   7
      DO 100 I=1,M                                                      AVER   8
      K=LX(I)+K                                                         AVER   9
      AT=0.0                                                            AVER  10
      TADX=0.0                                                          AVER  11
      DO 50 J=KK,K                                                      AVER  12
      TADX=TADX+(A(J)*TW(J))                                            AVER  13
      AT=AT+A(J)                                                        AVER  14
   50 CONTINUE                                                          AVER  15
      WT=TADX/AT                                                        AVER  16
      KK=K+1                                                            AVER  17
      IF(PRINTS .GT. 0) WRITE(6,101) NODE(IW,I),WT                      AVER  18
      LUU=LUU+1                                                         AVER  19
      NODEN4(LUU)=NODE(IW,I)                                            AVER  20
      WT1(LUU)=WT-460.0                                                 AVER  21
  101 FORMAT(/,13X,34HAVERAGE WALL TEMPERATURE FOR NODE ,I2,4H IS ,F7.2, AVER  22
     115H DEG. R,)                                                      AVER  23
  100 CONTINUE                                                          AVER  24
      RETURN                                                            AVER  25
      END                                                               AVER  26
```

```
      SUBROUTINE FLOWNO(PT2E,PS3A,XX,L,KOOL)                            FLOWNO   2
      DIMENSION PS3A(1),XX(1)                                           FLOWNO   3
      K=0                                                               FLOWNO   4
      KK=0                                                              FLOWNO   5
      M=1                                                               FLOWNO   6
      IF(KOOL .EQ. 4) M=2                                               FLOWNO   7
      DO 2 I=M,L                                                        FLOWNO   8
      IF(PT2E-PS3A(I)) 3,3,4                                            FLOWNO   9
    4 IF(K) 2,2,5                                                       FLOWNO  10
    3 IF(K) 6,6,7                                                       FLOWNO  11
    6 XLOC1=XX(I)                                                       FLOWNO  12
      IF(I-L) 8,9,9                                                     FLOWNO  13
    8 K=1                                                               FLOWNO  14
      GO TO 2                                                           FLOWNO  15
    7 IF(I-L) 2,9,9                                                     FLOWNO  16
    9 XLOC2=XX(L)                                                       FLOWNO  17
      IF(KK) 20,20,21                                                   FLOWNO  18
   20 WRITE(6,1)                                                        FLOWNO  19
   21 IF(KOOL .GT. 1) GO TO 25                                          FLOWNO  20
      WRITE(6,22) XLOC1,XLOC2                                           FLOWNO  21
   22 FORMAT(5X,20HFROM AXIAL LOCATION ,F5.1,40H THRU END OF COOLING SUR FLOWNO  22
     1FACE LOCATED AT ,F5.1,1H.,/)                                      FLOWNO  23
      GO TO 2                                                           FLOWNO  24
   25 WRITE(6,23) XLOC1,XLOC2                                           FLOWNO  25
   23 FORMAT(6X,21HFROM SLOT LOCATED AT ,F5.1,35H THRU LAST COOLING SLOT FLOWNO  26
     1 LOCATED AT ,F5.1,1H.,/)                                          FLOWNO  27
      GO TO 2                                                           FLOWNO  28
    5 XLOC2=XX(I)                                                       FLOWNO  29
      IF(KK) 11,11,12                                                   FLOWNO  30
   11 WRITE(6,1)                                                        FLOWNO  31
      KK=1                                                              FLOWNO  32
   12 IF(KOOL .GT. 1) GO TO 15                                          FLOWNO  33
      WRITE(6,14) XLOC1,XLOC2                                           FLOWNO  34
      GO TO 16                                                          FLOWNO  35
   15 WRITE(6,17) XLOC1,XLOC2                                           FLOWNO  36
   16 K=0                                                               FLOWNO  37
   17 FORMAT(5X,21HFROM SLOT LOCATED AT ,F5.1,40H TO (BUT NOT INCLUDING) FLOWNO  38
     1 SLOT LOCATED AT ,F5.1,1H.,/)                                     FLOWNO  39
    2 CONTINUE                                                          FLOWNO  40
    1 FORMAT(     //,21X,38HPROGRAM PREDICTS REVERSE COOLANT FLOW.,/26X,2 FLOWNO  41
     18H(PROGRAM UTILIZES ZERO FLOW),//)                                FLOWNO  42
   14 FORMAT(15X,20HFROM AXIAL LOCATION ,F5.1,19H TO AXIAL LOCATION ,F5. FLOWNO  43
     11,1H.,/)                                                          FLOWNO  44
      RETURN                                                            FLOWNO  45
      END                                                               FLOWNO  46
```

```
      SUBROUTINE PSOLN(W1,W2,P,WT,PT,K)                                  PSOLN   2
      DIMENSION W1(3), W2(3), P(3)                                       PSOLN   3
      A11=P(K 2)*(W1(K-1)-W1(K))+P(K-1)*(W1(K)-W1(K-2))+P(K)*(W1(K-2)-W1 PSOLN   4
     1(K-1))                                                             PSOLN   5
      A12=P(K-2)*(W2(K-1)-W2(K))+P(K-1)*(W2(K)-W2(K-2))+P(K)*(W2(K-2)-W2 PSOLN   6
     1(K-1))                                                             PSOLN   7
      A21=(W1(K-2))*(W1(K-2))*(P(K-1)-P(K))+(W1(K-1))*(W1(K-1))*(P(K)-P( PSOLN   8
     1K-2))+(W1(K))*(W1(K))*(P(K-2)-P(K-1))                              PSOLN   9
      A22=(W2(K-2))*(W2(K-2))*(P(K-1)-P(K))+(W2(K-1))*(W2(K-1))*(P(K)-P( PSOLN  10
     1K-2))+(W2(K))*(W2(K))*(P(K-2)-P(K-1))                              PSOLN  11
      A31=(W1(K-2)*W1(K-2))*((W1(K-1)*P(K))-(W1(K)*P(K-1)))+(W1(K-1)*W1( PSOLN  12
     1K-1))*((W1(K)*P(K-2))-(W1(K-2)*P(K)))+(W1(K))*(W1(K))*((W1(K-2)*P( PSOLN  13
     2K-1))-(W1(K-1)*P(K-2)))                                            PSOLN  14
      A32=(W2(K-2)*W2(K-2))*((W2(K-1)*P(K))-(W2(K)*P(K-1)))+(W2(K-1)*W2( PSOLN  15
     1K-1))*((W2(K)*P(K-2))-(W2(K-2)*P(K)))+(W2(K))*(W2(K))*((W2(K-2)*P( PSOLN  16
     2K-1))-(W2(K-1)*P(K-2)))                                            PSOLN  17
      D1=(W1(K-2)*W1(K-2))*(W1(K-1)-W1(K))+(W1(K-1)*W1(K-1))*(W1(K)-W1(K PSOLN  18
     1-2))+(W1(K)*W1(K))*(W1(K-2)-W1(K-1))                               PSOLN  19
      D2=(W2(K-2)*W2(K-2))*(W2(K-1)-W2(K))+(W2(K-1)*W2(K-1))*(W2(K)-W2(K PSOLN  20
     1-2))+(W2(K)*W2(K))*(W2(K-2)-W2(K-1))                               PSOLN  21
      C11=A11/D1                                                         PSOLN  22
      C12=A12/D2                                                         PSOLN  23
      C21=A21/D1                                                         PSOLN  24
      C22=A22/D2                                                         PSOLN  25
      C31=A31/D1                                                         PSOLN  26
      C32=A32/D2                                                         PSOLN  27
      A=C11-C12                                                          PSOLN  28
      B=C21-C22                                                          PSOLN  29
      C=C31-C32                                                          PSOLN  30
      AA=-B/(2.*A)                                                       PSOLN  31
      BB = SQRT((B*B)-(4.*A*C))/(2.*A)                                   PSOLN  32
      IF(AA-BB) 2,2,3                                                    PSOLN  33
    2 WT=AA+BB                                                           PSOLN  34
      GO TO 4                                                            PSOLN  35
    3 WT=AA-BB                                                           PSOLN  36
    4 PT=WT*(WT*C11+C21)+C31                                             PSOLN  37
      RETURN                                                             PSOLN  38
      END                                                                PSOLN  39
```

```
      FUNCTION STRATE(X1,X2,Y1,Y2,X)                                    STRATE     2
      STRATE=(((Y2-Y1)/(X2-X1))*(X-X1))+Y1                              STRATE     3
      RETURN                                                            STRATE     4
      END                                                               STRATE     5
```

```
      SUBROUTINE COFLOW (PTP,PTS,TTP,TTS,GAMP,GAMS,RP,RS,WP,WS,PAMB,
     1AAGT,KK)
      DIMENSION BTA(150)
      COMMON XL(100),ACROSS(80),
     1YL1( 80),YL2( 80),PP(150),AA(150),XMM1(150),XMM2(150),TSS(150),
     2DENP1(150),VPP(150),TPP(150),DENS1(150),VSS(150),PT(100),
     3XMST( 80),TST( 80),DENST( 80),VST( 80),XMPT( 80),TPT(100),
     4DENPT(100),VPT(100)
      COMMON L,I
      COMMON/EXIT/ RSN,RPN,RPL,XP,ANL,RTE
C     PLM   *     *
      COMMON/PLM/PLMGD(43),RCN,ST(50),NRD(50),PLM(5,30,51),NFLM,PA,P6,
     1    OPDX,KDATA,ISHK,JSHK,TANE,EOR
      CF2=1.0
      FV=WS*SQRT(TTS)/(WP*SQRT(TTP)*CF2)
  300 IF(PTP-PTS)320,320,330
  320 PST=PTP
      GO TO 331
  330 PST=PTS
  331 A1T=WP*SQRT(TTP)/PTP*SQRT((RP/(GAMP*32.2))*((GAMP+1.)/2.)**((GAMP+
     11.)/(GAMP-1.)))
      C1=SQRT((2./(GAMP-1.))*((GAMP+1.)/2.)**((GAMP+1.)/(GAMP-1.)))
      C2=C1/A1T
      PSTOP=.5*PAMB
      PRANG=PST-PSTOP
      DELP=PRANG/149.
    5 P=PST-DELP
      I=0
      GO TO 350
  340 P=P-DELP
  350 Y=SQRT((RP*GAMS/(RS*GAMP))*((GAMP-1.)/(GAMS-1.))*(1.-(P/PTS)**((GA
     1MS-1.)/GAMS)))*(PTS/PTP)*(P/PTS)**(1./GAMS)
      Z=((PTP/P)**(1./GAMP))/SQRT(1.-(P/PTP)**((GAMP-1.)/GAMP))
      A=((FV/Y)+Z)/C2
      XM1=SQRT((2./(GAMP-1.))*((PTP/P)**((GAMP-1.)/GAMP)-1.))
      XM2=SQRT((2./(GAMS-1.))*((PTS/P)**((GAMS-1.)/GAMS)-1.))
      TP=TTP/(1.+((GAMP-1.)/2.)*XM1*XM1)
      TS=TTS/(1.+((GAMS-1.)/2.)*XM2*XM2)
      DENP=P*144./(RP*TP)
      DENS=P*144./(RS*TS)
      CP=SQRT(GAMP*32.2*RP*TP)
      CS=SQRT(GAMS*32.2*RS*TS)
      VP=XM1*CP
      VS=XM2*CS
      AP=WP*144./(DENP*VP)
      AS=A-AP
      BETA=(AP/GAMP)*(1./(XM1*XM1)-1.)+(CF2*AS/GAMS)*(1./(XM2*XM2)-1.)
      I=I+1
      BTA(I)=BETA
      AA(I)=A
      XMM1(I)=XM1
      XMM2(I)=XM2
      PP(I)=P
      TSS(I)=TS
      DENP1(I)=DENP
      DENS1(I)=DENS
      VPP(I)=VP
```

```
      VSS(I)=VS                                                         COFLOW   59
      TPP(I)=TP                                                         COFLOW   60
      IF(BTA(I) .LE. 0.) GO TO 1000                                     COFLOW   61
      IF(P-PSTOP)1000,340,340                                           COFLOW   62
 1000 IF(KK) 998,998,1001                                               COFLOW   63
  998 IF(BTA(I) .LE. 0.) I=I-1                                          COFLOW   64
      GO TO 999                                                         COFLOW   65
 1001 IF(BTA(I) -0.) 1003,1003,1002                                     COFLOW   66
 1003 CALL TABLEL(BTA,AA,0.0,AAA,DUM,I)                                 COFLOW   67
      J=I-1                                                             COFLOW   68
      GO TO 1010                                                        COFLOW   69
 1012 CALL TABLEL(PP,AA,PAMB ,AAA,DUM,I)                                COFLOW   70
      J=I                                                               COFLOW   71
 1010 CF2=AAA/AACT                                                      COFLOW   72
      DO 1017 I=1,J                                                     COFLOW   73
 1017  AA(I)=AA(I)/CF2                                                  COFLOW   74
      I=J                                                               COFLOW   75
      PPN=SQRT(AS/(3.1415927*CF2)+RPL**2)                               COFLOW   76
      PTE=RPN*1.1                                                       COFLOW   77
      RSN=SQRT(AP/(3.1415927*CF2)+RPN**2)                               COFLOW   78
      P8=P/14.7                                                         COFLOW   79
  999 RETURN                                                            COFLOW   80
      END                                                               COFLOW   81
```

```
      SUBROUTINE STORE1(FP,FF,I,N)                                      STORE1   2
      DIMENSION FP1(5),FF1(5)                                           STORE1   3
      IF(N .GT. 0) GO TO 50                                             STORE1   4
      FP1(I)=FP                                                         STORE1   5
      FF1(I)=FF                                                         STORE1   6
      GO TO 100                                                         STORE1   7
   50 FP=FP1(I)                                                         STORE1   8
      FF=FF1(I)                                                         STORE1   9
  100 RETURN                                                            STORE1  10
      END                                                               STORE1  11
```

```
      SUBROUTINE STORE(HGAT,AT,I,N)
      DIMENSION HG(5),A(5)                                    STORE   2
      IF(N .GT. 0) GO TO 50                                   STORE   3
      A(I)=AT                                                 STORE   4
      HG(I)=HGAT                                              STORE   5
      GO TO 100                                               STORE   6
   50 HGAT=HG(I)                                              STORE   7
      AT=A(I)                                                 STORE   8
  100 RETURN                                                  STORE   9
      END                                                     STORE  10
                                                              STORE  11
```

```
      SUBROUTINE AXAREA(XI,XF,XA,AREAM,IA,KK,KKK,XU1,YU1,XU2,YU2)        AXAREA   2
      DIMENSION XA(1),AREAM(1),XU1(1),YU1(1),XU2(1),YU2(1)               AXAREA   3
      COMMON XL(100),ACROSS(80),                                         AXAREA   4
     1YL1( 80),YL2( 80),PP(150),AA(150),XMM1(150),XMM2(150),TRS(150),    AXAREA   5
     2DENP1(150),VPP(150),TRP(150),DENS1(150),VSS(150),PY(100),          AXAREA   6
     3XMST( 80),TST( 80),DENST( 80),VST( 80),XMPT( 80),TPT(100),         AXAREA   7
     4DENPT(100),VPT(100)                                                AXAREA   8
      COMMON L,LL                                                        AXAREA   9
      XCH=(XF-XI)                                                        AXAREA  10
      K=XCH                                                              AXAREA  11
      XCH1=K                                                             AXAREA  12
      IF(XCH1 .EQ. XCH) GO TO 50                                         AXAREA  13
      K=K+2                                                              AXAREA  14
      GO TO 51                                                           AXAREA  15
   50 K=K+1                                                              AXAREA  16
   51 L=0                                                                AXAREA  17
      YL(1)=XI                                                           AXAREA  18
      DO 22 I=1,K                                                        AXAREA  19
      DO 11 J=1,KK                                                       AXAREA  20
      IF(XL(I).EQ.XU1(1)) GO TO 9                                        AXAREA  21
      IF(XL(I).GT.XU1(J)) GO TO 10                                       AXAREA  22
      YL1(I)=STRATE(XU1(J-1),XU1(J),YU1(J-1),YU1(J),XL(I))               AXAREA  23
      GO TO 11                                                           AXAREA  24
    9 YL1(I)=YU1(1)                                                      AXAREA  25
      GO TO 11                                                           AXAREA  26
   10 CONTINUE                                                           AXAREA  27
   11 DO 21 J=1,KKK                                                      AXAREA  28
      IF(XL(I).EQ.XU2(1)) GO TO 19                                       AXAREA  29
      IF(XL(I).GT.XU2(J)) GO TO 20                                       AXAREA  30
      YL2(I)=STRATE(XU2(J-1),XU2(J),YU2(J-1),YU2(J),XL(I))               AXAREA  31
      GO TO 21                                                           AXAREA  32
   19 YL2(I)=YU2(1)                                                      AXAREA  33
      GO TO 21                                                           AXAREA  34
   20 CONTINUE                                                           AXAREA  35
   21 L=L+1                                                              AXAREA  36
      AGROSS=3.14159*(ABS(YL1(I)*YL1(I)-YL2(I)*YL2(I)))                  AXAREA  37
      IF(IA .EQ. 0) GO TO 15                                             AXAREA  38
      IF(XL(I)-XA(1)) 15,16,16                                           AXAREA  39
   16 IF(XL(I)-XA(IA)) 17,17,15                                          AXAREA  40
   15 AMINUS=0.0                                                         AXAREA  41
      GO TO 18                                                           AXAREA  42
   17 CALL TABLEL(XA,AREAM,XL(I),AMINUS,DUM,IA)                          AXAREA  43
   18 ACROSS(I)=AGROSS-AMINUS                                            AXAREA  44
      IF(I+1.GE.K) GO TO 23                                              AXAREA  45
      XL(I+1)=XL(I)+1.0                                                  AXAREA  46
      GO TO 22                                                           AXAREA  47
   23 XL(K)=XF                                                           AXAREA  48
   22 CONTINUE                                                           AXAREA  49
      RETURN                                                             AXAREA  50
      END                                                                AXAREA  51
```

```
      SUBROUTINE GATHER(A,K,I)                                          GATHER   2
      DIMENSION A(1)                                                    GATHER   3
      COMMON XL(100),ACROSS(80),                                        GATHER   4
     1YL1( 80),YL2( 30),PP(150),AA(150),XMM1(150),XMM2(150),TRS(150),  GATHER   5
     2DENP1(150),VPP(150),TRP(150),DENS1(150),VSS(150),PT(100),        GATHER   6
     3XMST( 80),TST( 80),DENST( 80),VST( 80),XMPT( 80),TPT(100),       GATHER   7
     4DENPT(100),VPT(100)                                               GATHER   8
      COMMON IDUM,LL                                                    GATHER   9
      IF(K-1) 5,6,7                                                     GATHER  10
    5 DO 13 M=1,I                                                       GATHER  11
      CALL TABLEL(AA,PP,A(M),PT(M),DUM,LL)                              GATHER  12
      CALL TABLEL(AA,XMM2,A(M),XMST(M),DUM,LL)                          GATHER  13
      CALL TABLEL(AA,TRS,A(M),TST(M),DUM,LL)                            GATHER  14
      CALL TABLEL(AA,DENS1,A(M),DENST(M),DUM,LL)                        GATHER  15
      CALL TABLEL(AA,VSS,A(M),VST(M),DUM,LL)                            GATHER  16
   13 CONTINUE                                                          GATHER  17
      GO TO 20                                                          GATHER  18
    6 DO 11 M=1,I                                                       GATHER  19
      CALL TABLEL(AA,PP,A(M),PT(M),DUM,LL)                              GATHER  20
      CALL TABLEL(AA,XMM1,A(M),XMPT(M),DUM,LL)                          GATHER  21
      CALL TABLEL(AA,TRP,A(M),TPT(M),DUM,LL)                            GATHER  22
      CALL TABLEL(AA,DENP1,A(M),DENPT(M),DUM,LL)                        GATHER  23
      CALL TABLEL(AA,VPP,A(M),VPT(M),DUM,LL)                            GATHER  24
   11 CONTINUE                                                          GATHER  25
      GO TO 20                                                          GATHER  26
    7 DO 12 M=1,I                                                       GATHER  27
      CALL TABLEL(AA,PP,A(M),PT(M),DUM,LL)                              GATHER  28
      CALL TABLEL(AA,XMM1,A(M),XMPT(M),DUM,LL)                          GATHER  29
      CALL TABLEL(AA,XMM2,A(M),XMST(M),DUM,LL)                          GATHER  30
      CALL TABLEL(AA,TRP,A(M),TPT(M),DUM,LL)                            GATHER  31
      CALL TABLEL(AA,TRS,A(M),TST(M),DUM,LL)                            GATHER  32
      CALL TABLEL(AA,DENP1,A(M),DENPT(M),DUM,LL)                        GATHER  33
      CALL TABLEL(AA,DENS1,A(M),DENST(M),DUM,LL)                        GATHER  34
      CALL TABLEL(AA,VPP,A(M),VPT(M),DUM,LL)                            GATHER  35
      CALL TABLEL(AA,VSS,A(M),VST(M),DUM,LL)                            GATHER  36
   12 CONTINUE                                                          GATHER  37
   20 RETURN                                                            GATHER  38
      END                                                               GATHER  39
```

```
      SUBROUTINE CPAGMA (MO,TTO,CP,GM)                                  CPAGMA   2
      REAL MO                                                           CPAGMA   3
      DIMENSION TT(16),CPT(16),GMT(16)                                  CPAGMA   4
      DATA TT/100.,250.,500.,600.,700.,800.,900.,1000.,1250.,1500.,2000.CPAGMA   5
     1,2500.,3000.,3500.,4000.,4200./                                   CPAGMA   6
      DATA CPT/.239,.2395,.24,.2405,.2419,.2430,.245,.2485,.2565,.2645, CPAGMA   7
     1.2775,.2867,.2935,.298,.302,.3035/                                CPAGMA   8
      DATA GMT/1.402,1.402,1.401,1.399,1.397,1.392,1.386,1.381,1.365,1.3CPAGMA   9
     15,1.325,1.315,1.305,1.298,1.293,1.292/                            CPAGMA  10
      NCP=16                                                            CPAGMA  11
      GM=1.4                                                            CPAGMA  12
      SMO=MO*MO                                                         CPAGMA  13
      DO 5 I=1,NCP                                                      CPAGMA  14
      GMO=GM                                                            CPAGMA  15
      CG=(GM-1.0)/2.                                                    CPAGMA  16
      TO=TTO/(1.+CG*SMO)                                                CPAGMA  17
      CALL TABLEL(TT,GMT,TO,GM,DUM,NCP)                                 CPAGMA  18
      IF (ABS((GMO-GM)/GM)-.001) 6,6,5                                  CPAGMA  19
    5 CONTINUE                                                          CPAGMA  20
    6 CALL TABLEL(TT,CPT,TO,CP,DUM,NCP)                                 CPAGMA  21
      RETURN                                                            CPAGMA  22
      END                                                               CPAGMA  23
```

```
      SUBROUTINE PRNDTL (T,PR)                                          PRNDTL   2
      IF (T-900.) 1,1,2                                                 PRNDTL   3
    1 PR=.76-.0001*T                                                    PRNDTL   4
      GO TO 3                                                           PRNDTL   5
    2 IF (T-1400.) 4,4,5                                                PRNDTL   6
    4 PR=.705-.C0004*T                                                  PRNDTL   7
      GO TO 3                                                           PRNDTL   8
    5 PR=.65                                                            PRNDTL   9
    3 CONTINUE                                                          PRNDTL  10
      RETURN                                                            PRNDTL  11
      END                                                               PRNDTL  12
```

```
      OVERLAY(XRHP,11,1)
      PROGRAM TRANCL
      COMMON /CPPCPG/ CPG
      COMMON /SHIFT/ TS,UA,K12,N12,PT1,TT1,DUM1,K23,N23,WSET,CPG,DUM2,
     *       DUM3,PORS,M1,M,DUM4,KOOL
      DIMENSION      A(80),TM(80),LX(10),
     1     WZ(80),XX(81),XXX(80),PS3A(80),TAWOA(80),TT3E(80),
     3   XMT(3), XMTT(3), XP(3)
      COMMON/CC/ NODENG(10),WT1(10),LUU,KOOLT
      COMMON /LINK5/ HGT(100), XN(2,20), YN(2,20), NODE(2,20), IM, IABC
      COMMON XT1(1840),PSGT(500),TAWOT(100),RHOT(100),VGT(100)
      COMMON /PRINT/ PRINT1, PRINT2, PRINT3, PRINT4, PRINT5,
     *               PRINT6, PRINT7, PRINT8, PRINT9, PRINT0
      INTEGER PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8
     1,PRINT9,PRINT0
      REAL K12,K23    ,N12,N23
      IJK=1
      L=0
      J=1
      JJ=0
      XX(1)=XN(IM,1)
      DO 400 I=1,M
      XL=SQRT(((XN(IM,I)-XN(IM,I+1))*(XN(IM,I)-XN(IM,I+1)))+((YN(IM,I)-
     1YN(IM,I+1))*(YN(IM,I)-YN(IM,I+1))))
      LX(I)=XL
      L=L+LX(I)
      LLL=LX(I)
      COSTH=(XN(IM,I+1)-XN(IM,I))/XL
      Z=(YN(IM,I+1)-YN(IM,I))/(XN(IM,I+1)-XN(IM,I))
      DX=XL/LX(I)
      N=1
      DO 401 K=1,LLL
      J=J+1
      XX(J)=XN(IM,I)+(N*DX*COSTH)
      N=N+1
  401 CONTINUE
      DO 402 K=1,LLL
      JJ=JJ+1
      YY=Z*(XX(JJ)-XN(IM,I))+YN(IM,I)
      YYY=Z*(XX(JJ+1)-XN(IM,I))+YN(IM,I)
      A(JJ)=3.14159*DX*(YY+YYY)
      XXX(JJ)=(XX(JJ)+XX(JJ+1))/2.
  402 CONTINUE
  400 CONTINUE
      PS3T=0.0
      DO 12 J=1,L
      CALL TABLEL(XT1,PSGT,XXX(J),PS3A(J),DUM,M1)
      CALL TABLEL(XT1,TAWOT,XXX(J),TAWOA(J),DUM,M1)
      PS3T=PS3T+PS3A(J)
      TT3E(J)=(TAWOA(J)+TT1)/2.
   12 CONTINUE
      AL=L
      PS3AT=PS3T/AL
      PT2E=PT1-(0.25*(PT1-PS3AT))
      SMALL=10000.0
      DO 70 I=1,L
      SMALL=AMIN1(SMALL,PS3A(I))
```

```
   70 CONTINUE                                                         TRANCL  59
      IF(PT1 .GT. SMALL) GO TO 933                                     TRANCL  60
      WRITE(6,934)                                                     TRANCL  61
  934 FORMAT(1H1,/////-4X,"SOURCE PRESSURE FOR TRANSPIRATION COOLING IS TRANCL  62
     1TOO LOW TO PROVIDE COOLING.",/,20X,"PROGRAM CONTINUING ASSUMING NO TRANCL  63
     2 COOLING.",/,30X,"(SUBROUTINE TRANCL)")                          TRANCL  64
      KOOL=0                                                           TRANCL  65
      GO TO 999                                                        TRANCL  66
  933 IF(WSET-0.0) 453,450,451                                         TRANCL  67
  451 CALL SETFLO(IJK,L,SMALL,WSET,UA,CPC,TT1,TS,PT2E,TT2E,K23,N23,A,  TRANCL  68
     1PS3A,WZ,AL,TT3E)                                                 TRANCL  69
      WT=WSET                                                          TRANCL  70
      GO TO 22                                                         TRANCL  71
  453 W=1.                                                             TRANCL  72
      LL=0                                                             TRANCL  73
      KW=0                                                             TRANCL  74
      LLL=0                                                            TRANCL  75
      KKK=0                                                            TRANCL  76
   13 ZE=EXP(UA/(W*CPC*3600.))                                         TRANCL  77
      TT2E=TS-((TS-TT1)/ZE)                                            TRANCL  78
      SIGM12=(70.59*PT1)/(TT2E+TT1)                                    TRANCL  79
      WT=(SIGM12*(PT1-PT2E)/K12)**(1./N12)                             TRANCL  80
      WTT=0.0                                                          TRANCL  81
      DO 20 J=1,L                                                      TRANCL  82
      SIGM23=(70.59*PS3A(J))/(TT2E+TT3E(J))                            TRANCL  83
      IF(PT2E-PS3A(J)) 71,71,72                                        TRANCL  84
   71 WOA=0.0                                                          TRANCL  85
      GO TO 73                                                         TRANCL  86
   72 WOA=(SIGM23*(PT2E-PS3A(J))/K23)**(1./N23)                        TRANCL  87
   73 WZ(J)=WOA*A(J)/144.                                              TRANCL  88
      WTT=WTT+WZ(J)                                                    TRANCL  89
   20 CONTINUE                                                         TRANCL  90
      IF(LLL) 180,180,22                                               TRANCL  91
  180 KW=KW+1                                                          TRANCL  92
      IF(KW-3) 300,300,301                                             TRANCL  93
  301 KW=1                                                             TRANCL  94
  300 XWT(KW)=WT                                                       TRANCL  95
      XWTT(KW)=WTT                                                     TRANCL  96
      XP(KW)=PT2E                                                      TRANCL  97
      IF((ABS(WTT-WT)/WT)-.01) 22,22,201                               TRANCL  98
  201 IF(KKK) 202,202,200                                              TRANCL  99
  202 IF(WTT-WT) 200,60,60                                             TRANCL 100
   60 WTMAX=(SIGM12*(PT1-SMALL)/K12)**(1./N12)                         TRANCL 101
      IF(WTT-WTMAX) 21,21,61                                           TRANCL 102
   61 WTT=WTMAX                                                        TRANCL 103
   21 W=.25*WTT+0.75*WT                                                TRANCL 104
      PT2E=PT1-((K12/SIGM12)*(W**N12))                                 TRANCL 105
      GO TO 13                                                         TRANCL 106
  200 PCR=0.1                                                          TRANCL 107
  805 PT2E=XP(KW)+PCR                                                  TRANCL 108
      IF(PT2E .LT. PT1) GO TO 804                                      TRANCL 109
      PCR=PCR/10.0                                                     TRANCL 110
      GO TO 805                                                        TRANCL 111
  804 KKK=KKK+1                                                        TRANCL 112
      W=(SIGM12*(PT1-PT2E)/K12)**(1./N12)                              TRANCL 113
      IF(KKK-2) 13,13,205                                              TRANCL 114
  205 IF(WTT-WT)13,13,206                                              TRANCL 115
```

```
  206   CALL PSOLN(XWT,XWTT,XP,WT,DUM,3)                               NCL     116
        W=WT                                                            TRANCL  117
        PT2E=PT1-((K12/SIGM12)*(W**N12))                                TRANCL  118
        LLL=1                                                           TRANCL  119
        GO TO 13                                                        TRANCL  120
   22   DO 30 J=1,L                                                     TRANCL  121
        CALL TABLEL(XT1,HGT,XXX(J),HGO,DUM,M1)                          TRANCL  122
        CALL TABLEL(XT1,RHOT,XXX(J),RHO,DUM,M1)                         TRANCL  123
        CALL TABLEL(XT1,VGT,XXX(J),VG,DUM,M1)                           TRANCL  124
        STO=HGO/(RHO*VG*CPC*3600.)                                      TRANCL  125
        IF(WZ(J)) 170,170,171                                           TRANCL  126
  170   TH(J)=TAWDA(J)                                                  TRANCL  127
        GO TO 30                                                        TRANCL  128
  171   F=(WZ(J)/(A(J)*PORS))/(RHO*VG)                                  TRANCL  129
        ZZ=F/STO                                                        TRANCL  130
        FF=SQRT((0.5*ZZ)*(0.5*ZZ)+1.)-0.5*ZZ                            TRANCL  131
        ETTA=(FF*HGO*A(J))/(WZ(J)*CPC*144.*3600.)                       TRANCL  132
        TH(J)=((ETTA*TAWDA(J))+TT2E)/(ETTA+1.)                          TRANCL  133
   30   CONTINUE                                                        TRANCL  134
        IF(LL-0)24,24,25                                                TRANCL  135
   24   LL=1                                                            TRANCL  136
        DO 35 J=1,L                                                     TRANCL  137
        TT3E(J)=(TW(J)+TT3E(J))/2.                                      TRANCL  138
   35   CONTINUE                                                        TRANCL  139
        W=WT                                                            TRANCL  140
        KK=1                                                            TRANCL  141
        LLL=0                                                           TRANCL  142
        KKK=0                                                           TRANCL  143
        IF(WSET-.0) 13,13,451                                           TRANCL  144
   25   IF(PRINTS .GT. 0) WRITE(6,700) IABC                             TRANCL  145
  700   FORMAT(1H1,/,23X,21HTRANSPIRATION COOLING,/,27X,12HSURFACE NO. ,I2 TRANCL  146
       1,/)                                                             TRANCL  147
        CALL WVER(A,TW,LX,NODE,M,IN,PRINTS)                             TRANCL  148
        IF(PRINTS .GT. 0) WRITE(6,160) WT                               TRANCL  149
  160   FORMAT(//,22X,22HTOTAL COOLANT FLOW IS ,F6.2,8H LB/SEC.)        TRANCL  150
        IF(PRINTS .GT. 0) WRITE(6,165) PT2E                             TRANCL  151
  165   FORMAT(/,20X,26HTOTAL COOLANT PRESSURE IS ,F6.2,9H LB/SQIN.)    TRANCL  152
        CALL FLOWNO(PT2E,PS3A,XX,L,KOOL)                                TRANCL  153
  999   CONTINUE                                                        TRANCL  154
        END                                                             TRANCL  155
```

```
      SUBROUTINE SETFLO(IJK,L,PS3MIN,WT,UA,CPC,TT1,TS,PT2E,TT2E,K23,N23, SETTRN   2
     1A,PS3A,WZ,RR,TT3E)                                                SETTRN   3
      DIMENSION WTT1(10),PT2E1(10),PS3A(1),A(1),TT3E(1),WZ(80)          SETTRN   4
      REAL K23,N23                                                      SETTRN   5
      J=1                                                               SETTRN   6
      K=1                                                               SETTRN   7
      NT=0                                                              SETTRN   8
      ZE=EXP(UA/(WT*CPC*3600.))                                         SETTRN   9
      TT2E=TS-((TS-TT1)/ZE)                                             SETTRN  10
      PT2E=PS3MIN                                                       SETTRN  11
    5 PT2E=PT2E+(1./J)                                                  SETTRN  12
    6 WTT=0.0                                                           SETTRN  13
      IF(IJK-2) 80,81,81                                                SETTRN  14
   81 DO 100 I=1,L                                                      SETTRN  15
      ZZ=PS3A(I)/PT2E                                                   SETTRN  16
      IF(ZZ-1.) 101,102,102                                             SETTRN  17
  102 WZ(I)=0.0                                                         SETTRN  18
      GO TO 103                                                         SETTRN  19
  101 SQMACH=(2./(K23-1.))*((ZZ**((1.-K23)/K23))-1.)                    SETTRN  20
      ZA=(PT2E*A(I)*N23*144.0)/SQRT(TT2E)                               SETTRN  21
      ZB=(1.+(((K23-1.)/2.)*SQMACH))**((K23+1.)/(K23-1.))               SETTRN  22
      WZ(I)=SQRT((32.174*K23*SQMACH)/(RR*ZB))*ZA                        SETTRN  23
  103 WTT=WTT+WZ(I)                                                     SETTRN  24
  100 CONTINUE                                                          SETTRN  25
      GO TO 110                                                         SETTRN  26
   80 DO 50 I=1,L                                                       SETTRN  27
      IF(PT2E-PS3A(I)) 51,51,52                                         SETTRN  28
   51 WOA=0.0                                                           SETTRN  29
      GO TO 53                                                          SETTRN  30
   52 SIGM23=(17.6415*PS3A(I))/(TT2E+TT3E(I))                           SETTRN  31
      WOA=(SIGM23*(PT2E-PS3A(I))/K23)**(1./N23)                         SETTRN  32
   53 WZ(I)=(WOA*A(I))/144.0                                            SETTRN  33
      WTT=WTT+WZ(I)                                                     SETTRN  34
   50 CONTINUE                                                          SETTRN  35
  110 IF((ABS(WT-WTT))-.01) 55,55,54                                    SETTRN  36
   54 IF((IABS(J))-10) 57,56,55                                         SETTRN  37
   56 NT=NT+1                                                           SETTRN  38
      WTT1(NT)=WTT                                                      SETTRN  39
      PT2E1(NT)=PT2E                                                    SETTRN  40
   57 IF(WT-WTT) 58,55,59                                               SETTRN  41
   58 IF((IABS(J))-10) 60,61,60                                         SETTRN  42
   60 IF((IABS(J))-1) 63,63,5                                           SETTRN  43
   63 J=-J-3                                                            SETTRN  44
      GO TO 5                                                           SETTRN  45
   61 K=1                                                               SETTRN  46
      IF(NT-4) 5,64,64                                                  SETTRN  47
   64 IF(K-1) 5,65,65                                                   SETTRN  48
   65 CALL TABLEL(WTT1,PT2E1,WT,PT2E,DUM,NT)                            SETTRN  49
      J=11                                                              SETTRN  50
      GO TO 6                                                           SETTRN  51
   59 IF((IABS(J))-10) 66,5,66                                          SETTRN  52
   66 IF((IABS(J))-1) 5,5,67                                            SETTRN  53
   67 J=-J+6                                                            SETTRN  54
      GO TO 5                                                           SETTRN  55
   55 RETURN                                                            SETTRN  56
      END                                                               SETTRN  57
```

```
      OVERLAY(FMP,11,2)
      PROGRAM FILMCL
      COMMON /NODEN1/ NODE(2,20) ,S(2,20)
      COMMON /SHIFT/ TS,UA,K12,N12,PT1,TT1,RR,DUM1,DUM2,WSET,CPC,GAMMA,
     *       COX,DUM3,KK,MMM,N,KOOL
      DIMENSION                        XL(21),YL(21),D(20),COSTH(20),
     2X(21,9),A(20),TRG1(21,9),TWEFF(21,9),R(9),DX(20),PS(20),
     3              DXA(150),TAII(150),WZ(20),LXLX(10)
     4    ,XWT(3), XWTT(3), XP(3)
      COMMON/CC/ NODEN,(13),WT1(13),LUU,KOOLT
      COMMON/CCC/ FS(2)
      COMMON /LINK6/ HGT(100), YU(2,20), Y.(2,20), LX(2,20), IW, IABC
      COMMON X1(15+0),XPS(500),XTRG(200),XVG(100)
      COMMON /PRINT/ PRINT1, PRINT2, PRINT3, PRINT4, PRINT5,
     *               PRINT6, PRINT7, PRINT8, PRINT9, PRINT0
      INTEGER PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8
     1,PRINT9,PRINT0
      REAL K12,N12
      L=0
      IJK=1
      PIE=3.14159
      DO 1 I=1,N
      DP=SQRT(((XU(IW,I+1)-XU(IW,I))**2)+((YU(IW,I+1)-YU(IW,I))**2))
      SS=S(IW,I)*S(IW,I)
      DPP=SQRT((DP*DP)-SS)
      COSTH(I)=(XU(IW,I+1)-XU(IW,I))/DP
      TEEA=ATAN((YU(IW,I)-YU(IW,I+1))/(XU(IW,I+1)-XU(IW,I)))
      PHEE=ATAN(S(IW,I)/DPP)
      OMEGA=TEEA-PHEE
      SP=S(IW,I)/COS(OMEGA)
      SW=SQRT((SP*SP)-SS)
      D(I)=DPP-SW
      XL(I)=XU(IW,I)
      YL(I)=YU(IW,I)-SP
      DX(I)=D(I)/8.0
      X(I,1)=0.0
      DO 2 J=2,8
    2 X(I,J)=X(I,J-1)+DX(I)
    1 X(I,9)=D(I)
      PS3T=0.0
      DO 200 I=1,N
      A(I)=(2.*PIE*S(IW,I)*(YL(I)+(S(IW,I)*(2.-(COSTH(I)*COSTH(I)))/
     1(2.*COSTH(I)))))/144.0
      CALL TABLFL(X1,XPS,XL(I),PS(I),DUM,KK)
      PS3T=PS3T+PS(I)
  200 CONTINUE
      AL=N
      PS3TA=PS3T/AL
      PT=PT1-(.25*(PT1-PS3TA))
      SMALL=10000.0
      DO 201 I=1,N
      SMALL=AMIN1(SMALL,PS(I))
  201 CONTINUE
      IF(PT1 .GT. SMALL) GO TO 933
      WRITE(6,934)
  934 FORMAT(1H1,/////,8X,"SOURCE PRESSURE FOR FILM COOLING IS TOO LOW T
     1O PROVIDE COOLING.",/,20X,"PROGRAM CONTINUING ASSUMING NO COOLING.
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      2",/,30X,"(SUBROUTINE FILMCL)")                                  FILMCL  59
      KOOL=0                                                           FILMCL  60
      GO TO 999                                                        FILMCL  61
  933 IF(WSET-0.0) 450,450,451                                         FILMCL  62
  451 CALL SETFLO(IJK,N,SMALL,WSET,UA,CPC,TT1,TS,PT,TC,GAMMA,COX,A,PS, FILMCL  63
     1WZ,PR,XL)                                                        FILMCL  64
      WT=WSET                                                          FILMCL  65
      GO TO 205                                                        FILMCL  66
  450 W=1.                                                             FILMCL  67
      KW=0                                                             FILMCL  68
      LLL=0                                                            FILMCL  69
      KKK=0                                                            FILMCL  70
      KAKA=0                                                           FILMCL  71
   13 ZE=EXP(UA/(W*CPC*3600.0))                                        FILMCL  72
      TC=TS-((TS-TT1)/ZE)                                              FILMCL  73
      SIGM12=(70.55*PT1)/(TC+TT1)                                      FILMCL  74
      WT=(SIGM12*(PT1-PT)/K12)**(1./N12)                               FILMCL  75
      IF(KAKA .GT. 0) GO TO 237                                        FILMCL  76
      KAKA=1                                                           FILMCL  77
      W=WT                                                             FILMCL  78
      GO TO 13                                                         FILMCL  79
  237 WTT=0.0                                                          FILMCL  80
      DO 202 I=1,N                                                     FILMCL  81
      ZZ=PS(I)/PT                                                      FILMCL  82
      IF(ZZ-1.) 300,301,301                                            FILMCL  83
  301 WZ(I)=0.0                                                        FILMCL  84
      GO TO 302                                                        FILMCL  85
  300 SQMACH=(2./(GAMMA-1.))*((ZZ**((1.-GAMMA)/GAMMA))-1.)             FILMCL  86
      ZA=(PT*A(I)*COX*144.0)/SQRT(TC)                                  FILMCL  87
      ZB=(1.+(((GAMMA-1.)/2.)*SQMACH))**((GAMMA+1.)/(GAMMA-1.))        FILMCL  88
      WZ(I)=SQRT((32.174*GAMMA*SQMACH)/(RR*ZB))*ZA                     FILMCL  89
  302 WTT=WTT+WZ(I)                                                    FILMCL  90
  202 CONTINUE                                                         FILMCL  91
      IF(LLL) 180,180,205                                              FILMCL  92
  180 KW=KW+1                                                          FILMCL  93
      IF(KW-3) 181,181,182                                             FILMCL  94
  182 KW=1                                                             FILMCL  95
  181 KWT(KW)=WT                                                       FILMCL  96
      KWTT(KW)=WTT                                                     FILMCL  97
      XP(KW)=PT                                                        FILMCL  98
      IF((ABS(WTT-WT))-.01) 205,205,185                                FILMCL  99
  185 IF(KKK) 402,402,400                                              FILMCL 100
  402 IF(WTT-WT) 400,60,60                                             FILMCL 101
   60 WTMAX=(SIGM12*(PT1-SMALL)/K12)**(1./N12)                         FILMCL 102
      IF(WTT-WTMAX) 401,401,61                                         FILMCL 103
   61 WTT=WTMAX                                                        FILMCL 104
  401 W=0.25*WTT+0.75*WT                                               FILMCL 105
      PT=PT1-((K12/SIGM12)*(W**N12))                                   FILMCL 106
      GO TO 13                                                         FILMCL 107
  400 PCR=0.1                                                          FILMCL 108
  805 PT=XP(KW)+PCR                                                    FILMCL 109
      IF(PT .LT. PT1) GO TO 804                                        FILMCL 110
      PCR=PCR/10.0                                                     FILMCL 111
      GO TO 805                                                        FILMCL 112
  804 KKK=KKK+1                                                        FILMCL 113
      W=(SIGM12*(PT1-PT)/K12)**(1./N12)                                FILMCL 114
      IF(KKK-2) 13,13,405                                              FILMCL 115
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 405   IF(WTT-WT) 13,13,406                                   FILMCL  116
 406   CALL PSOLN(XNT,XWTT,XP,WT,DUM,3)                       FILMCL  117
       W=WT                                                   FILMCL  118
       PT=PT1-((K12/SIGM12)*(W**N12))                         FILMCL  119
       LLL=1                                                  FILMCL  120
       GO TO 13                                               FILMCL  121
 205   RHOT=(144.*PT)/(RR*TC)                                 FILMCL  122
       DO 3 I=1,N                                             FILMCL  123
       LLL=0                                                  FILMCL  124
       IF(WZ(I) .LE. 0.0) GO TO 601                           FILMCL  125
       RHOS=RHOT*((PS(I)/PT)**(1./GAMMA))                     FILMCL  126
       VC=WZ(I)/(A(I)*RHOS)                                   FILMCL  127
       CALL TABLEL(X1,KVG,XL(I),VG,DUM,KK)                    FILMCL  128
       IF(VC-VG)4,4,5                                         FILMCL  129
 4     FV=1.+.4* ATAN((VG/VC)-1.0)                            FILMCL  130
       GO TO 6                                                FILMCL  131
 5     FV=(VC/VG)**(1.5*((VC/VG)-1.0))                        FILMCL  132
 6     PART2=1./(RHOS*VC*CPC*S(IW,I)*3600.)                   FILMCL  133
 601   DO 11 K=I,N                                            FILMCL  134
       IF(LLL-0) 20,21,20                                     FILMCL  135
 21    JA=1                                                   FILMCL  136
       GO TO 22                                               FILMCL  137
 20    JA=2                                                   FILMCL  138
       TRG1(K,1)=TRG1(K-1,9)                                  FILMCL  139
 22    DO 7 J=JA,9                                            FILMCL  140
       XX=XL(K)+X(K,J)*COSTH(K)                               FILMCL  141
       CALL TABLEL(X1,KHG,XX,HG,DUM,KK)                       FILMCL  142
       IF(I-1) 8,9,8                                          FILMCL  143
 9     CALL TABLEL(X1,XTRG,XX,TRG,DUM,KK)                     FILMCL  144
       TRGG=TRG                                               FILMCL  145
       GO TO 25                                               FILMCL  146
 8     TRGG=TRG1(K,J)                                         FILMCL  147
 25    IF(JA-1) 27,26,27                                      FILMCL  148
 26    XXX=X(I,J)                                             FILMCL  149
       GO TO 10                                               FILMCL  150
 27    XXX=(XX-XL(I))/COSTH(K)                                FILMCL  151
 10    IF(WZ(I)-0.0) 602,602,603                              FILMCL  152
 602   THEF=TRGG                                              FILMCL  153
       GO TO 604                                              FILMCL  154
 603   PART1=(TRGG/TC)**0.6667                                FILMCL  155
       PART3=PART1*PART2*FV                                   FILMCL  156
       THEF=((TC-TRGG)/(1.0+3.6*(PART3*XXX*HG)))+TRGG         FILMCL  157
 604   TRG1(K,J)=THEF                                         FILMCL  158
       IF(K-I)7,12,7                                          FILMCL  159
 12    THEFF(I,J)=THEF                                        FILMCL  160
       R(J)=(((XX-XL(I))*(YU(IW,I+1)-YL(I)))/(XU(IW,I+1)-XL(I)))+YL(I)  FILMCL  161
 7     CONTINUE                                               FILMCL  162
       IF(K-I) 11,16,11                                       FILMCL  163
 16    LLL=1                                                  FILMCL  164
       DO 14 M=1,8                                            FILMCL  165
       L=L+1                                                  FILMCL  166
       DXA(L)=PIF*DX(I)*(R(M)+R(M+1))                         FILMCL  167
       TAII(L)=((THEFF(I,M)+THEFF(I,M+1))/2.0)                FILMCL  168
 14    CONTINUE                                               FILMCL  169
 11    CONTINUE                                               FILMCL  170
 3     CONTINUE                                               FILMCL  171
       DO 500 I=1,NNM                                         FILMCL  172
```

```
                                                                        FILMCL   173
      LKLX(I)=LX(IN,I)*8                                                FILMCL   174
  582 CONTINUE                                                          FILMCL   175
      FORCE=0.0                                                         FILMCL   176
      SEC1=(GAMMA-1.0)/GAMMA                                            FILMCL   177
      SEC2=(RR*TT1)/(32.174*144.0)                                      FILMCL   178
      DO 710 I=1,N                                                      FILMCL   179
      PRAT=(PS(I)/PT )**SEC1                                            FILMCL   180
      FORCE=FORCE+(((WZ(I)*WZ(I))/(A(I)*PS(I)))*SEC2*PRAT*COSTH(I))     FILMCL   181
  703 CONTINUE                                                          FILMCL   182
      IF(PRINT5 .GT. 0) WRITE(6,731) IABC                               FILMCL   183
  731 FORMAT(1H1,/,28X,12HFILM COOLING,/,27X,12HSURFACE NO. ,I2,/)      FILMCL   184
      CALL AVEP(DXA,TAII,LXLX,NODE,MNK,IK,PRINT5)                       FILMCL   185
      IF(PRINT5 .GT. 0) WRITE(6,160) WT                                 FILMCL   186
  160 FORMAT(//,22X,22HTOTAL COOLANT FLOW IS ,F6.2,8H LB/SEC.)          FILMCL   187
      IF(PRINT5 .GT. 0) WRITE(6,165) PT                                 FILMCL   188
  165 FORMAT(/,20X,26HTOTAL COOLANT PRESSURE IS ,F6.2,9H LB/SQIN.)      FILMCL   189
      IF(PRINT5 .GT. 0) WRITE(6,735) FORCE                              FILMCL   190
  735 FORMAT(/,13X,"TOTAL RESULTANT SLOT COOLANT MOMENTUM FLUX IS ",    FILMCL   191
     1F7.2," LB.")                                                      FILMCL   192
      CALL FLOWNC(PT,PS,XL,N,KOOL)                                      FILMCL   193
      FS(IN)= FORCE                                                     FILMCL   194
  999 CONTINUE                                                          FILMCL   195
      END
```

```
      SUBROUTINE SETFLO(IJK,L,PS3MIN,WT,UA,CPC,TT1,TS,PT2E,TT2E,K23,N23,  SETFLM   2
     1A,PS3A,WZ,RR,TT3E)                                                 SETFLM   3
      DIMENSION WTT1(10),PT2E1(10),PS3A(1),A(1),TT3E(1),WZ(80)           SETFLM   4
      REAL K23,N23                                                       SETFLM   5
      J=1                                                                SETFLM   6
      K=0                                                                SETFLM   7
      NT=0                                                               SETFLM   8
      ZE=EXP(UA/(WT*CPC*3600.))                                          SETFLM   9
      TT2E=TS-((TS-TT1)/ZE)                                              SETFLM  10
      PT2E=PS3MIN                                                        SETFLM  11
    5 PT2E=PT2E+(1./J)                                                   SETFLM  12
    6 WTT=0.0                                                            SETFLM  13
      IF(IJK-2) 80,81,81                                                 SETFLM  14
   81 DO 100 I=1,L                                                       SETFLM  15
      ZZ=PS3A(I)/PT2E                                                    SETFLM  16
      IF(ZZ-1.) 101,102,102                                              SETFLM  17
  102 WZ(I)=0.0                                                          SETFLM  18
      GO TO 103                                                          SETFLM  19
  101 SONACH=(2./(K23-1.))*((ZZ**((1.-K23)/K23))-1.)                     SETFLM  20
      ZA=(PT2E*A(I)*N23*144.0)/SQRT(TT2E)                                SETFLM  21
      ZB=(1.+(((K23-1.)/2.)*SONACH))**((K23+1.)/(K23-1.))                SETFLM  22
      WZ(I)=SQRT((32.174*K23*SONACH)/(RR*ZB))*ZA                         SETFLM  23
  103 WTT=WTT+WZ(I)                                                      SETFLM  24
  100 CONTINUE                                                           SETFLM  25
      GO TO 110                                                          SETFLM  26
   80 DO 50 I=1,L                                                        SETFLM  27
      IF(PT2E-PS3A(I)) 51,51,52                                          SETFLM  28
   51 WOA=0.0                                                            SETFLM  29
      GO TO 53                                                           SETFLM  30
   52 SIGH23=(17.6415*PS3A(I))/(TT2E+TT3E(I))                            SETFLM  31
      WOA=(SIGH23*(PT2E-PS3A(I))/K23)**(1./N23)                          SETFLM  32
   53 WZ(I)=(WOA*A(I))/144.0                                             SETFLM  33
      WTT=WTT+WZ(I)                                                      SETFLM  34
   50 CONTINUE                                                           SETFLM  35
  110 IF((ABS(WT-WTT))-.01) 55,55,54                                     SETFLM  36
   54 IF((IABS(J))-10) 57,56,55                                          SETFLM  37
   56 NT=NT+1                                                            SETFLM  38
      WTT1(NT)=WTT                                                       SETFLM  39
      PT2E1(NT)=PT2E                                                     SETFLM  40
   57 IF(WT-WTT) 58,55,59                                                SETFLM  41
   58 IF((IABS(J))-10) 60,61,60                                          SETFLM  42
   60 IF((IABS(J))-1) 63,63,5                                            SETFLM  43
   63 J=-J-3                                                             SETFLM  44
      GO TO 5                                                            SETFLM  45
   61 K=1                                                                SETFLM  46
      IF(NT-4) 5,64,64                                                   SETFLM  47
   64 IF(K-1) 5,65,65                                                    SETFLM  48
   65 CALL TABLEL(WTT1,PT2E1,WT,PT2E,DUM,NT)                             SETFLM  49
      J=11                                                               SETFLM  50
      GO TO 6                                                            SETFLM  51
   59 IF((IABS(J))-10) 66,5,66                                           SETFLM  52
   66 IF((IABS(J))-1) 5,5,67                                             SETFLM  53
   67 J=-J+5                                                             SETFLM  54
      GO TO 5                                                            SETFLM  55
   55 RETURN                                                             SETF..   56
      END                                                                SETFLM  57
```

```
      OVERLAY(XRHP,11,3)
      PROGRAM CONFLM
      COMMON /CONFLM/     N,K5(2,20),REN1(21),HXP1(2,20),F1(21),NN1,
     *  HXT,AR,SVHX,10
      COMMON /SHIFT/ TS,UAS,K12,N12,PT1,TT1,DUM1,DUM2,DUM3,NSET,DUM4,
     *     DUM5,DUM6,DUM7,NN4,MA3,NC,NTC
      COMMON /NODEN1/ NODE(2,20) ,SH(2,20)
      DIMENSION
     2 ANG(20),SL(20),DSL(20),TC(20,15),TW(20,15),TG(20,15),TF(20,15),
     3RENL(21),HXPL(21),WCF1(22),MN1(22),FL(21),AHX(20),AS(20),A(20),
     4TA(21),PS(20),TCK(20),WC(20),PT2(5),WT(5),WCT(5),TS5(20),PS6(20),
     5TRG(20,15)
      DIMENSION LXLX(10), XIX(20), WTT50(3), WT50(3), P50(3)
      COMMON/CC/ NODEN4(10),WT1(10),LUU,KOOLT
      COMMON/CCC/ FS(2)
      EQUIVALENCE (TCS,TT2), (PS6(1),PS(1))
      REAL K12,K5,N12,MV,MN,MN1
      COMMON X1(1840),PS1(500),IG1(20),VG1(100)
      COMMON /LINK5/ HG1(100),  X(2,20),  R(2,20), LX(2,20), IW, IABC
      COMMON /PRINT/ PRINT1, PRINT2, PRINT3, PRINT4, PRINT5,
     *              PRINT6, PRINT7, PRINT8, PRINT9, PRINT0
      INTEGER PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8
     1,PRINT9,PRINT0
      DATA WCF1/.0,.04295,.09134,.13599,.17944,.22132,.26130,.29909,.334
     142,.36708,.39689,.42374,.44754,.46827,.48592,.50053,.51219,.52100,
     2,52710,.53063,.53177,.0/
      DATA MN1/.0,.05,.10,.15,.20,.25,.30,.35,.40,.45,.50,.55,.60,.65,.7
     10,.75,.80,.85,.90,.95,1.0,.0/
  116 FORMAT(1H1,/////,3X,"SOURCE PRESSURE FOR CONVECTION-FILM COOLING I
     2S TO LOW TC PROVIDE COOLING.",/,20X,"PROGRAM CONTINUING ASSUMING N
     30 COOLING.",/,30X,"(SUBROUTINE CONFLM)")
  117 FORMAT(1H1,/////,18X,"CONVECTION-FILM COOLING FLOW BALANCE FAILED.
     1",/,25X,"PROGRAM EXECUTION IS STOPPED.",/,30X,"(SUBROUTINE CONFLM)
     3")
  181 FORMAT(1H1,/////,7X,"CONVECTION-FILM COOLING TEMPERATURE ITERATION
     1 FAILED TO CONVERGE.",/,25X,"PROGRAM EXECUTION IS STOPPED.",/,30X,
     2"(SUBROUTINE CONFLM)")
      NN3=21
      INC=10
      AEFF = 0.4
      DO 20 J=1,N
      ANG(J)=ATAN((R(IW,J)-R(IW,J+1))/(X(IW,J+1)-X(IW,J)))
      SL(J)=(X(IW,J+1)-X(IW,J))/(COS(ANG(J)))
      DSL(J) = SL(J)/(INC-1)
      CALL TABLEL(X1,TG1,X(IW,J),T,DUM,NN4)
      IF(NTC-4) 290,291,291
  290 JK=J
      GO TO 292
  291 JK=J+1
  292 CALL TABLEL(X1,PS1,X(IW,JK),PS(J),DUM,NN4)
      DO 16 I=1,INC
   16 TRG(J,I) = T
   20 CONTINUE
      AST=0.0
      DO 200 J=1,NC
      AHX(J)=(R(IW,J+1)+.5*(SL(J)*SIN(ANG(J))-HXT*COS(ANG(J))))*6.28318
     1  *HXT
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```
      AS(J) = 3.14159*(R(IW,J)-SH(IW,J)*COS(ANG(J))+R(IW,J+1))*SL(J)     CONFLM  59
  280 AST = AST + AS(J)                                                   CONFLM  60
      DO 71 I=1,NN1                                                       CONFLM  61
      RENL(I) = ALOG(REN1(I))                                             CONFLM  62
      FL(I) = ALOG(F1(I))                                                 CONFLM  63
   71 HXPL(I) = ALOG(HXP1(I))                                             CONFLM  64
C * * * * COOLANT FLOW BALANCE * * * * * * * * * * * * * * * * * * * * *  CONFLM  65
      M1=1                                                                CONFLM  66
      PMAX=PS(1)                                                          CONFLM  67
      PMIN=PS(1)                                                          CONFLM  68
      DO 262 I=2,N                                                        CONFLM  69
      IF(PS(I)-PMIN) 265,263,263                                          CONFLM  70
  265 PMIN=PS(I)                                                          CONFLM  71
      GO TO 262                                                           CONFLM  72
  263 IF(PS(I)-PMAX) 262,262,264                                          CONFLM  73
  264 PMAX=PS(I)                                                          CONFLM  74
  262 CONTINUE                                                            CONFLM  75
      IF(WSET.GT.0.0)   GO TO 1000                                        CONFLM  76
      IF(PT1.LT.PMIN) GO TO 203                                           CONFLM  77
 1000 IF(NTC.LT.4)   GO TO 275                                            CONFLM  78
      DO 271 J=1,NC                                                       CONFLM  79
      SH(IW,J) = SH(IW,J+1)                                               CONFLM  80
  271 K5(IW,J) = K5(IW,J+1)                                               CONFLM  81
  275 K=1                                                                 CONFLM  82
      MM=0                                                                CONFLM  83
      LL=1                                                                CONFLM  84
      J=1                                                                 CONFLM  85
C * * * * SOURCE FLOW PRESSURE-FLOW BALANCE * * * * * * * * * * * * * * * CONFLM  86
      IF(WSET.GT.0.)GO TO 219                                             CONFLM  87
      IF(M1.GT.1) GO TO 201                                               CONFLM  88
      KKK=0                                                               CONFLM  89
      WB=10.                                                              CONFLM  90
      PT2(J)=PT1-0.2*(PT1-PMIN)                                           CONFLM  91
  201 WA=WB                                                               CONFLM  92
      KKK=KKK+1                                                           CONFLM  93
      TT2=TS-(TS-TT1)/EXP(UAS/(864.*WA))                                  CONFLM  94
      S12=35.31*(PT1+PT2(J))/(TT1+TT2)                                    CONFLM  95
      WB=(S12*(PT1-PT2(J))/K12)**(1./N12)                                 CONFLM  96
      CK=(WB-WA)/WB                                                       CONFLM  97
      IF(ABS(CK)-.01) 204,204,202                                         CONFLM  98
  202 IF(KKK .LT. 20) GO TO 201                                           CONFLM  99
  307 WRITE (6,117)                                                       CONFLM 100
      STOP                                                                CONFLM 101
  203 WRITE(6,116)                                                        CONFLM 102
      NTC=0                                                               CONFLM 103
      GO TO 70                                                            CONFLM 104
  204 WT(J)=WB                                                            CONFLM 105
      KKK=0                                                               CONFLM 106
      WMAX=(S12*(PT1-PMIN)/K12)**(1./N12)                                 CONFLM 107
C * * * * DISCHARGE PRESSURE-FLOW BALANCE * * * * * * * * * * * * * * * * CONFLM 108
  254 WCT(J)=0.0                                                          CONFLM 109
      DO 205 I=1,NC                                                       CONFLM 110
      K10=0                                                               CONFLM 111
      IF(PT2(J)-PS6(I)) 206,206,207                                       CONFLM 112
  206 WC(I)=0.0                                                           CONFLM 113
      IF(M1 .EQ. 1) TS5(I)=TT2                                            CONFLM 114
      GO TO 213                                                           CONFLM 115
```

```
  207 IF(M1-1) 208,208,209
  208 IF(K-1) 210,210,209
  210 WCC=WT(J)*AS(I)/AST
      TS5(I) = TT2
      GO TO 211
  209 IF(WC(I).GT.0.0001) GO TO 256
      WC(I) = 0.1
  256 WCC=WC(I)
  211 S5=35.31*PS6(I)/TS5(I)
  255 FM=WCC*SQRT(TT2)/(AHX(I)*AR*PT2(J))
      K10=K10+1
      CALL TABLEL(WCF1,MN1,FM,MN,DUM,NN3)
      TR=1./(1.+.2*MN**2)
      PR=TR**3.5
      REN=ALOG(518400.*HD*WCC/(AHX(I)*.0005336*(TT2*TR)**.7841))
      IF(REN.GT.RENL(NN1)) REN=RENL(NN1)
      IF(REN.LT.RENL(1)) REN=RENL(1)
      CALL TABLEL(RENL,FL,REN,FF,DUM,NN1)
      HXF=SL(I)*TT2*TR*EXP(FF)/(3.621*HD*PT2(J)*PR*(AHX(I)*AR)**2)
      WC(I)=SQRT((PT2(J)-PS6(I))/(HXF+K5(IW,I)/S5))
      CK=(WC(I)-WCC)/WC(I)
      IF(ABS(CK)-.005) 213,213,261
  261 WCC = WC(I)
      IF(K10-20) 255,307,307
  213 WCT(J)= WCT(J)+WC(I)
  205 CONTINUE
      IF(K-2) 214,214,215
  214 CK=(WCT(J)-WT(J))/WCT(J)
      IF(ABS(CK)-0.003) 215,215,216
  216 IF(WSET .GT. 0.0) GO TO 218
      IF(K-1) 220,220,221
  220 K=2
      IF (WCT(J)-WT(J)) 222,222,223
  222 LO=2
      GO TO 224
  223 LO=1
  234 IF (WCT(J)-WMAX) 224,224,225
  224 WB=(WT(J)+WCT(J))/2.
      GO TO 235
  225 WB=(WT(J)+WMAX)/2.
  235 J=J+1
      IF(J-4) 226,227,227
  227 DO 228 JJ=1,2
      WT(JJ)=WT(JJ+1)
      PT2(JJ)=PT2(JJ+1)
  228 WCT(JJ)=WCT(JJ+1)
      J=3
  226 IF(LL.GT.1) GO TO 240
      PT2(J)=PT1-K12*(WB**N12)/S12
      GO TO 201
  240 PT2(J)=PT2(J-1) + Z
      IF(PT2(J) .LT. PT1) GO TO 201
      Z=Z/*^.0
      GO TO 240
  221 IF (LO-1) 229,229,230
  229 IF(WCT(J)-WT(J)) 231,231,232
  232 IF(LL-1) 234,234,233
```

```
233 IF(J-3) 231,236,236                                CONFLM
236 DO 933 JA=1,3                                      CONFLM
    WT50(JA)=WT(JA)                                    CONFLM
    WTT50(JA)=WCT(JA)                                  CONFLM
933 P5.(JA)=PT2(JA)                                    CONFLM
    CALL PSOLM(WT50,WTT50,P50,WB,P,3)                  CONFLM
    PT2(J)=P                                           CONFLM
    K=J                                                CONFLM
    GO TO 254                                          CONFLM
231 LL=2                                               CONFLM
    Z=0.1                                              CONFLM
    WB=WT(J)                                           CONFLM
    GO TO 235                                          CONFLM
230 IF (LL-1) 237,237,238                              CONFLM
237 IF(WT(J)-WCT(J)) 239,239,224                       CONFLM
239 LL=2                                               CONFLM
    Z=-0.1                                             CONFLM
    WB=WT(J)                                           CONFLM
    GO TO 235                                          CONFLM
238 IF(WT(J)-WCT(J)) 235,235,241                       CONFLM
241 IF(J-3) 235,236,236                                CONFLM
219 IF(K1.GT.1) GO TO 254                              CONFLM
    WT(J)=WSET                                         CONFLM
    TT2=TS-(TS-TT1)/EXP(UAS/(864.*WSET))               CONFLM
    PT2(J) = PMAX + 1.                                 CONFLM
    GO TO 254                                          CONFLM
218 IF(K-1) 242,242,243                                CONFLM
242 K=2                                                CONFLM
    IF(WCT(J)-WSET) 244,244,245                        CONFLM
244 LO=2                                               CONFLM
    Z=0.249                                            CONFLM
246 IF(J.EQ.4) GO TO 267                               CONFLM
    J = J + 1                                          CONFLM
    GO TO 269                                          CONFLM
267 DO 268 I=2,4                                       CONFLM
    WCT(I-1)= WCT(I)                                   CONFLM
268 PT2(I-1)=PT2(I)                                    CONFLM
269 WT(J)=WSET                                         CONFLM
    PT2(J)=PT2(J-1)+Z                                  CONFLM
    GO TO 254                                          CONFLM
245 LO=1                                               CONFLM
    Z=-0.249                                           CONFLM
    GO TO 246                                          CONFLM
243 IF(LO-1) 247,247,248                               CONFLM
247 IF(WCT(J)-WSET) 249,249,250                        CONFLM
249 LL=2                                               CONFLM
    Z=0.05                                             CONFLM
270 MM=MM+1                                            CONFLM
    GO TO 246                                          CONFLM
250 IF(LL-1) 246,245,251                               CONFLM
251 IF(MM-3) 270,252,252                               CONFLM
248 IF(WCT(J)-WSET) 250,250,260                        CONFLM
260 IF(LL-1) 253,253,270                               CONFLM
253 LL=2                                               CONFLM
    Z=-0.05                                            CONFLM
    GO TO 246                                          CONFLM
252 IF(LO.LT.2) GO TO 259
```

```
      DO 257 I=1,4
      JJ = 5-I
      TA(I)=WCT(JJ)
  257 A(I)=PT2(JJ)
      DO 258 I=1,4
      WCT(I)=TA(I)
  258 PT2(I)=A(I)
  259 CALL TABLEL(WCT,PT2,WSET,P,DUM,4)
      PT2(J)=P
      K=3
      GO TO 254
  215 WCT(1)=WCT(J)
      PT2(1)=PT2(J)
      DO 282 J=1,N
      DO 281 I=1,INC
  281 TG(J,I) = TRG(J,I)
  282 CONTINUE
      HY=0.0
      DO 21 J=1,NC
      IF(WC(J) .GT. 0.00001) GO TO 295
      DO 296 I=1,INC
  296 TW(J,I)=TG(J,I)
      GO TO 21
  295 ASHX=SVHX*AHX(J)*SL(J)/12.
      CALL TABLEL(X1,HG1,X(IW,J),HG,DUM,NN4)
      KKK = 0
C * * * * BRANCH FOR TYPE CONFIGURATION - PARALLEL OR COUNTERFLOW * * *
      IF (NTC-4)  2,3,3
C * * * * PARALLEL FLOW THERMAL ANALYSIS * * * * * * * * * * * * * * *
    3 TC(J,1) = TCS
      IF(J.GT.1) GO TO 4
      TF(J,1) = TG(J,1)
    4 SX=0.0
      DO 7 I=2,INC
      VIS = 0.0005336*TC(J,I-1)**.7941
      REN=ALOG(518400.*HD*WC(J)/(VIS*AHX(J)*AR))
      IF(REN.GT.RENL(NN1)) REN=RENL(NN1)
      IF(REN.LT.RENL(1)) REN=RENL(1)
      CALL TABLEL(RENL,HXPL,REN,HXP,DUM,NN1)
      CALL PRNDT1(TC(J,I-1),PR)
      HHX=.24*WC(J)*EXP(HXP)/(AHX(J)*AR*(PR)**.6667)
      UA =   1./(1./(HHX*AEFF*ASHX) + 518400./(HG*AS(J)))
      C=UA*DSL(J)/(.24*SL(J)*WC(J))
      IF(J.GT.1) GO TO 10
      TF(J,I) = TG(J,I)
   10 TFB = (TF(J,I)+TF(J,I-1))/2.
      TC(J,I) = TFB-(TFB-TC(J,I-1))/(EXP(C))
      TW(J,I) = UA*(TF(J,I)/(HHX*AEFF*ASHX)+518400.*TC(J,I)/(HG*AS(J)))
      IF(I.GT.2) GO TO 7
      TW(J,1)=UA*(TF(J,1)/(HHX*AEFF*ASHX)+518400.*TC(J,1)/(HG*AS(J)))
    7 CONTINUE
      IF(NC.GT.J) GO TO 8
      IF(N.GT.NC) GO TO 8
      ANG(J+1) = 0.0
    8 ACD=  2831P*(R(IW,J+1)-.5*SH(IW,J)*COS(ANG(J+1)))*SH(IW,J)
      TF(J+1,1)=TC(J,INC)
      WCF=WC(J)*SQRT(TF(J+1,1))/(.93*ACD*PS(J))
```

```
      CALL TABLEL(WCF1,MN1,FM,MN,DUM,NN3)                               CONFLM  287
      TR=1./(1.+.2*MN**2)                                               CONFLM  288
      TSS(J)=TF(J+1,1)*TR                                               CONFLM  289
      VCO = 53.35*WCF*TR*SQRT(TF(J+1,1))                                CONFLM  290
      MV=MV+VCO*WC(J)*COS(ANG(J+1))/32.174                              CONFLM  291
      IF(NC.GT.J) GO TO 5                                               CONFLM  292
      IF(N.EQ.NC) GO TO 21                                              CONFLM  293
    5 CALL TABLEL(X1,VG1,X(IW,J+1),VG,DUM,NN4)                          CONFLM  294
      IF(VG-VCO) 299,299,298                                            CONFLM  295
  298 FV=1.+.4*ATAN(VG/VCO-1.)                                          CONFLM  296
      GO TO 300                                                         CONFLM  297
  299 FV=(VCO/VG)**(1.5*(VCO/VG-1.))                                    CONFLM  298
  300 CC=HG*ACO/(WC(J)*SH(IW,J)*124416.)                                CONFLM  299
      SXX=0.0                                                           CONFLM  300
      JJ=J+1                                                            CONFLM  301
      CALL TABLEL (X1,HG1,X(IW,JJ),HG,DUM,NN4)                          CONFLM  302
      DO 9 M=JJ,N                                                       CONFLM  303
      DO 289 I=2,INC                                                    CONFLM  304
      SXX=SXX+DSL(M)                                                    CONFLM  305
      EFF=1./(1.+3.6*SXX*(TG(M,I)/ TF(JJ,1))**.6667*FV*CC)              CONFLM  306
  289 TF(M,I)=TG(M,I)-EFF*(TG(M,I)-TF(JJ,1))                            CONFLM  307
      IF(M.EQ.JJ) GO TO 9                                               CONFLM  308
      TG(M,1)= TF(M-1,INC)                                              CONFLM  309
      DO 288 I=2,INC                                                    CONFLM  310
  288 TG(M,I)=TF(M,I)                                                   CONFLM  311
    9 CONTINUE                                                          CONFLM  312
      GO TO 21                                                          CONFLM  313
C * * * COUNTERFLOW THERMAL ANALYSIS * * * * * * * * * * * * * * * * *   CONFLM  314
    2 IF(M1-1) 277,277,25                                               CONFLM  315
  277 TF(J,1) = TG(J,1)/3.+ (TCS)*.6667                                 CONFLM  316
      TC(J,1) = TF(J,1)                                                 CONFLM  317
   25 CALL TABLEL(X1,VG1,X(IW,J),VG,DUM,NN4)                            CONFLM  318
      ACO=6.28318*(R(IW,J)-.5*SH(IW,J)*COS(ANG(J)))*SH(IW,J)            CONFLM  319
      WCF=WC(J)*SQRT(TF(J,1))/(.980*ACO*PS(J))                          CONFLM  320
      CALL TABLEL(WCF1,MN1,WCF,MN,DUM,NN3)                              CONFLM  321
      TR=1./(1.+.2*MN**2)                                               CONFLM  322
      TSS(J) = TR*TF(J,1)                                               CONFLM  323
      VCO = 53.35*WCF*TR*SQRT(TF(J,1))                                  CONFLM  324
      MV=MV+VCO*WC(J)*COS(ANG(J))/32.174                                CONFLM  325
      IF(VG-VCO) 302,302,301                                            CONFLM  326
  301 FV = 1. + .4*ATAN(VG/(VCO) - 1.)                                  CONFLM  327
      GO TO 303                                                         CONFLM  328
  302 FV=(VCO/VG)**(1.5*(VCO/VG-1.))                                    CONFLM  329
  303 CC = HG*ACO/(WC(J)*SH(IW,J)*124416.)                              CONFLM  330
      SX = 0.0                                                          CONFLM  331
      DO 19 I=2,INC                                                     CONFLM  332
      SX = SX + DSL(J)                                                  CONFLM  333
      EFF = 1./(1.+3.6*SX*(TG(J,I)/TF(J,1))**.6667*FV*CC)               CONFLM  334
      TF(J,I) = TG(J,I)-EFF*(TG(J,I)-TF(J,1))                           CONFLM  335
      TFB = (TF(J,I)+TF(J,I-1))/2.                                      CONFLM  336
      VIS = 0.0005336*TC(J,I-1)**.7641                                  CONFLM  337
      CALL PRNDT1(TC(J,I-1),PR)                                         CONFLM  338
      REN = ALOG(518400.*HD*WC(J)/(VIS*AHX(J)*AR))                      CONFLM  339
      IF(REN.GT.RENL(NN1))  REN=RENL(NN1)                               CONFLM  340
      IF(REN.LT.RENL(1))  REN=RENL(1)                                   CONFLM  341
      CALL TABLEL(RENL,HXPL,REN,HXP,DUM,NN1)                            CONFLM  342
      HHX = .24*HC(J)*EXP(HXP)/(AHX(J)*AR*(PR)**.6667)                  CONFLM  343
```

```
      UA =   1./(1./(HHX*AEFF*ASHX) + 518400./(HG*AS(J)))               CONFLM   344
      C = UA*DSL(J)/(.24*SL(J)*WC(J))                                    CONFLM   345
      TC(J,I)=TFB - (TFB-TC(J,I-1))*EXP(C)                               CONFLM   346
   19 TW(J,I) = UA*(TF(J,I)/(HHX*AEFF*ASHX)+ 518400.*TC(J,I)/(HG*AS(J))) CONFLM   347
      DTCS = TC(J,INC)-TCS                                               CONFLM   348
      KKK = KKK + 1                                                      CONFLM   349
      IF (ABS(DTCS) -3.)23,23,24                                         CONFLM   350
   24 TF(J,1) = TF(J,1) - .8*DTCS                                        CONFLM   351
      TC(J,1) = TF(J,1)                                                  CONFLM   352
      IF(KKK-20) 25,62,62                                                CONFLM   353
   62 WRITE (6,101)                                                      CONFLM   354
      STOP                                                               CONFLM   355
   23 TW(J,1) = TF(J,1)                                                  CONFLM   356
      TC(J,INC) = TCS                                                    CONFLM   357
      IF(N-J) 21,21,41                                                   CONFLM   358
   41 SXX =SX                                                            CONFLM   359
      JJ = J+1                                                           CONFLM   360
      DO 34 M=JJ,N                                                       CONFLM   361
      SXX = SXX - DSL(M)                                                 CONFLM   362
      DO 34 K = 1,INC                                                    CONFLM   363
      SXX = SXX + DSL(M)                                                 CONFLM   364
      EFF = 1./(1.+3.6*SXX*(TG(M,K)/TF(J,1))**.6667*FV*CC)               CONFLM   365
   34 TG(M,K) = TG(M,K) - EFF*(TG(M,K) - TF(J,1))                        CONFLM   366
   21 CONTINUE                                                           CONFLM   367
      M2=5*NC                                                            CONFLM   368
      IF(NTC.LT.4) GO TO 293                                             CONFLM   369
      JK1=1                                                              CONFLM   370
      JK2=NC                                                             CONFLM   371
      GO TO 294                                                          CONFLM   372
  293 JK1=2                                                              CONFLM   373
      JK2=NC+1                                                           CONFLM   374
  294 IF(M1-1) 273,273,276                                               CONFLM   375
  276 DO 272 I=JK1,JK2                                                   CONFLM   376
      IF (ABS(TF(I,1)-TCK(I))-5.) 272,272,273                            CONFLM   377
  272 CONTINUE                                                           CONFLM   378
      GO TO 283                                                          CONFLM   379
  273 M1=M1+1                                                            CONFLM   380
      DO 274 I=JK1,JK2                                                   CONFLM   381
  274 TCK(I)=TF(I,1)                                                     CONFLM   382
      IF (M1-M2) 279,279,280                                             CONFLM   383
  279 GO TO 275                                                          CONFLM   384
  280 WRITE (6,101)                                                      CONFLM   385
      STOP                                                               CONFLM   386
  283 IF(NTC-4) 35,13,13                                                 CONFLM   387
   35 IF(NC.EQ.N)  GO TO 36                                              CONFLM   388
      TW(N,1) = TW (N-1,INC)                                             CONFLM   389
      DO 37 K=2,INC                                                      CONFLM   390
   37 TW(N,K) = TG(N,K)                                                  CONFLM   391
      GO TO 36                                                           CONFLM   392
   13 IF(NC.EQ.N) GO TO 36                                               CONFLM   393
      DO 6 I=1,INC                                                       CONFLM   394
    6 TW(N,I)=TF(N,I)                                                    CONFLM   395
C * * * * SURFACE TEMPERATURE AVERAGING * * * * * * * * * * * * * * * *  CONFLM   396
   36 K = INC - 1                                                        CONFLM   397
      DO 17 J =1,N                                                       CONFLM   398
      TSUM=0.0                                                           CONFLM   399
      DO 15 I=2,K                                                        CONFLM   400
```

```
   18 TSUM=TSUM+TH(J,I)*(R(IW,J+1)+(SL(J)-DSL(J)*(I-1))*SIN(ANG(J)))     CONFLM   401
      T1=TH(J,1)*(R(IW,J+1)+(SL(J)-DSL(J)/4.)*SIN(ANG(J)))                CONFLM   402
      TN=TH(J,INC)*(R(IW,J+1)+DSL(J)*SIN(ANG(J))/4.)                      CONFLM   403
      A(J)=SL(J)*(R(IW,J+1)+ SL(J)*SIN(ANG(J))/2.)*6.28                   CONFLM   404
   17 TA(J)=3.14159*DSL(J)*(T1+2.*TSUM+TN)/A(J)                           CONFLM   405
      IF(PRINTS .GT. 0) WRITE(6,104) IARC                                 CONFLM   406
  104 FORMAT(1H1,/,23X,23HCONVECTION-FILM COOLING,/27X,12HSURFACE NO. ,   CONFLM   407
     1I2,/)                                                               CONFLM   408
      DO 430 I=1,M                                                        CONFLM   409
  430 LXLX(I)=LX(IW,I)                                                    CONFLM   410
      CALL AVER(A,TA,LXLX,NODE,MAB,IW,PRINTS)                             CONFLM   411
      IF(PRINTS .GT. 0)  WRITE(6,105) WCT(1),PT2(1), MV                   CONFLM   412
  105 FORMAT(//,22X,22HTOTAL COOLANT FLOW IS ,F6.2,8H LB/SEC.             CONFLM   413
     2        /,20X,26HTOTAL COOLANT PRESSURE IS ,F5.2,9H LB/SQIN.        CONFLM   414
     3        /,13X,"TOTAL RESULTANT SLOT COOLANT MOMENTUM FLUX IS ",     CONFLM   415
     4F7.2," LB.")                                                        CONFLM   416
      FS(IW)=MV                                                           CONFLM   417
      DO 431 I=1,M                                                        CONFLM   418
      TCK(I)=PS6(I)                                                       CONFLM   419
  431 XIX(I)=X(IW,I)                                                      CONFLM   420
      IF(NTC .NE. 4) GO TO 433                                            CONFLM   421
      DO 434 I=2,M                                                        CONFLM   422
  434 PS6(I)=TCK(I-1)                                                     CONFLM   423
  433 CALL FLOWSD(PT2(1),PS6,XIX,M,NTC)                                   CONFLM   424
   70 CONTINUE                                                            CONFLM   425
      END                                                                 CONFLM   426
```

```
      SUBROUTINE PRNDT1 (T,PR)                                          PRNDT1     2
      IF (T-900.) 1,1,2                                                 PRNDT1     3
    1 PR=.76-.0001*T                                                    PRNDT1     4
      GO TO 3                                                           PRNDT1     5
    2 IF (T-1400.) 4,4,5                                                PRNDT1     6
    4 PR=.705-.00004*T                                                  PRNDT1     7
      GO TO 3                                                           PRNDT1     8
    5 PR=.65                                                            PRNDT1     9
    3 CONTINUE                                                          PRNDT1    10
      RETURN                                                            PRNDT1    11
      END                                                               PRNDT1    12
```

```
      OVERLAY(XRHP,11,4)                                                CALFOR   2
      PROGRAM CALFOR                                                    CALFOR   3
      COMMON/ALL/ N,NN,NNN,ISURF(50),NODE(55),JSURF(5,2),XF(5),NTOT1,   CALFOR   4
     *            NOP,NP(10), AREA(80)                                  CALFOR   5
      COMMON /LINK6/ HI11(100), XN(2,20), YN(2,20), LX(2,20), IW, IABC  CALFOR   6
      COMMON /KOOL/KOOL(5)                                              CALFOR   7
      COMMON/BBB/ NODE15(50),FT1(50),LU1                                CALFOR   8
      COMMON/CCC/ FS(2)                                                 CALFOR   9
      FORCE=0.0                                                         CALFOR  10
      J=1                                                               CALFOR  11
      WRITE(6,1)                                                        CALFOR  12
    1 FORMAT(1H1,//,26X,"SYSTEM SURFACE FORCE FACTORS",//,20X,"NODE NO." CALFOR  13
     1,15X,"FORCE FACTOR (LB.)")                                        CALFOR  14
    2 FORMAT(23X,I2,21X,F9.3)                                           CALFOR  15
      LINE=6                                                            CALFOR  16
    7 DO 5 I=1,LU1                                                      CALFOR  17
      IF(J .EQ. NODE15(I)) GO TO 10                                     CALFOR  18
    5 CONTINUE                                                          CALFOR  19
   10 IF(LINE .GE. 55) GO TO 3                                          CALFOR  20
   11 WRITE(6,2) NODE15(I),FT1(I)                                       CALFOR  21
      FORCE=FORCE+FT1(I)                                                CALFOR  22
      J=J+1                                                             CALFOR  23
      LINE=LINE+1                                                       CALFOR  24
      IF(J .GT. LU1) GO TO 58                                           CALFOR  25
      GO TO 7                                                           CALFOR  26
    3 WRITE(6,1)                                                        CALFOR  27
      LINE=6                                                            CALFOR  28
      GO TO 11                                                          CALFOR  29
   58 DO 60 K=1,NNN                                                     CALFOR  30
      IF(KOOL(K) .GT. 1) GO TO 51                                       CALFOR  31
   60 CONTINUE                                                          CALFOR  32
      GO TO 70                                                          CALFOR  33
    4 FORMAT(6X,"COOLANT SLOT DISCHARGE FLOW FACTOR")                   CALFOR  34
   51 WRITE(6,4)                                                        CALFOR  35
      DO 55 K=1,IW                                                      CALFOR  36
      WRITE(6,8) FS(K)                                                  CALFOR  37
    8 FORMAT(46X,F9.3)                                                  CALFOR  38
   55 FORCE=FORCE+FS(K)                                                 CALFOR  39
   70 WRITE(6,9) FORCE                                                  CALFOR  40
    9 FORMAT(/,8X,"TOTAL NET SURFACE FORCE FACTOR",8X,F9.3)             CALFOR  41
      END                                                               CALFOR  42
```

```
      OVERLAY(XRHP,11,5)
      PROGRAM HOTPT
      COMMON XL(100),ACROSS(80),
     1YL1( 80),YL2( 80),PP(150),AA(150),XMM1(150),XMM2(150),TRS(150),
     2DENP1(150),VPP(150),TRP(150),DENS1(150),VSS(150),PT(100),
     3XMST( 80),TST( 80),DENST( 80),VST( 80),XMPT( 80),TPT(100),
     4DENPT(100),VPT(100),L,LL
      COMMON/ALL/ N,NN,NNN,ISURF(50),NODE(55),JSURF(5,2),XF(5),NTOT1,
     *                  NOP,NP(10), AREA(80)
      COMMON /LINK6/ HT11(100), YN(2,20), YM(2,20), LX(2,20), IW, IABC
      COMMON /PRINT/ PRINT1, PRINT2, PRINT3, PRINT4, PRINT5,
     *               PRINT6, PRINT7, PRINT8, PRINT9, PRINT0
      COMMON /HOT/ AT,CF11(80),CHIA(5),CTHIA(5),FFT,FPAT,HGAT,HIA(5,2),
     1ICS,ICSURF(5),II,IKJ,ISTREM(5),KK(5),KSURF(5),NODEN(5,20),N1,N2,
     2PTP,PTS,THETA(5,2),TTP,TTS,XF1,XI(5),XU1(20),XU2(20),X11(80),
     3YU1(20),YU2(20),Y11(80),I,KA(5,2)
      INTEGER PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8
     1,PRINT9,PRINT0
      IF(KA(I,II)) 31,31,32
   31 IF(II-1) 33,33,34
   33 CALL HEAT(XI(I),XF(I),TTS,PTS,THETA(I,II),HIA(I,II),XL,YL1,XMST,
     1TST,CTHETA,CHIA,X11,Y11,HT11,IKJ,          ISTREM(I),JSURF(I,II),
     2ICSURF,ICS,PRINT2,II,CF11)
      CALL AVERHT(X11,Y11,HT11,XU1,YU1,ICS,ICSURF,N1,IKJ,JSURF(I,II),
     1KSURF,NODEN,NNN,PRINT3,HGAT,AT)
      IF(PRINT0 .EQ. 0) GO TO 850
      CALL AVERFS(X11,Y11,CF11,XU1,YU1,ICS,ICSURF,N1,IKJ,JSURF(I,II),
     1KSURF,NODEN,NNN,XMST,PT,1.4,II,FPAT,FFT)
      GO TO 850
   34 CALL HEAT(XI(I),XF1   ,TTS,PTS,THETA(I,II),HIA(I,II),XL,YL2,XMST,
     1TST,CTHETA,CHIA,X11,Y11,HT11,IKJ,          ISTREM(I),JSURF(I,II),
     2ICSURF,ICS,PRINT2,II,CF11)
      CALL AVERHT(X11,Y11,HT11,XU2,YU2,ICS,ICSURF,N2,IKJ,JSURF(I,II),
     1KSURF,NODEN,NNN,PRINT3,HGAT,AT)
      IF(PRINT0 .EQ. 0) GO TO 850
      CALL AVERFS(X11,Y11,CF11,XU2,YU2,ICS,ICSURF,N2,IKJ,JSURF(I,II),
     1KSURF,NODEN,NNN,XMST,PT,1.4,II,FPAT,FFT)
      GO TO 850
   32 IF(II-1) 35,35,360
   35 CALL HEAT(XI(I),XF(I),TTP,PTP,THETA(I,II),HIA(I,II),XL,YL1,XMPT,
     1TPT,CTHETA,CHIA,X11,Y11,HT11,IKJ,          ISTREM(I),JSURF(I,II),
     2ICSURF,ICS,PRINT2,II,CF11)
      CALL AVERHT(X11,Y11,HT11,XU1,YU1,ICS,ICSURF,N1,IKJ,JSURF(I,II),
     1KSURF,NODEN,NNN,PRINT3,HGAT,AT)
      IF(PRINT0 .EQ. 0) GO TO 850
      CALL AVERFS(X11,Y11,CF11,XU1,YU1,ICS,ICSURF,N1,IKJ,JSURF(I,II),
     1KSURF,NODEN,NNN,XMPT,PT,1.35,II,FPAT,FFT)
      GO TO 850
  360 IF(NOP .EQ. N) GO TO 36
      IF(KK(I) .EQ. 0) GO TO 36
      N2=N2-1
      IF(XI(I) .GE. XU2(N2)) GO TO 850
      XF1=XU2(N2)
   36 CALL HEAT(XI(I),XF1   ,TTP,PTP,THETA(I,II),HIA(I,II),XL,YL2,XMPT,
     1TPT,CTHETA,CHIA,X11,Y11,HT11,IKJ,          ISTREM(I),JSURF(I,II),
     2ICSURF,ICS,PRINT2,II,CF11)
      CALL AVERHT(X11,Y11,HT11,XU2,YU2,ICS,ICSURF,N2,IKJ,JSURF(I,II),
```

```
                 1KSURF,NODEN,NNN,PRINT3,HGAT,AT)                          HOTPT     59
                  IF(PRINTC .EQ. 8) GO TO 850                              HOTPT     60
      68          CALL AVERFS(X11,Y11,CF11,XU2,YU2,ICS,ICSURF,N2,IKJ,JSURF(I,II), HOTPT 61
                 1KSURF,NODEN,NNN,XMPT,PT,1,35,II,FPAT,FFT)                HOTPT     62
             850  CONTINUE                                                 HOTPT     63
                  END                                                      HOTPT     64
```

```
      SUBROUTINE AVERHT(X,Y,HG,XU,YU,ICS,ICSURF,N,KP,JSURF,KSURF,       AVERHT   2
     1NODE,NNN,PRINT3,HGAT,AT)                                          AVERHT   3
      DIMENSION X(1),Y(1),HG(1),XU(1),YU(1),KSURF(1),NODE(5,20),        AVERHT   4
     1ICSURF(1)                                                         AVERHT   5
      INTEGER PRINT3                                                    AVERHT   6
      COMMON/AA/ NODE1(50),HT1(50),LU                                   AVERHT   7
      LU=0                                                              AVERHT   8
      IF(PRINT3 .EQ. 0) GO TO 300                                       AVERHT   9
      WRITE(6,101)                                                      AVERHT  10
  101 FORMAT(1H1,//,23X,34HAVERAGE HEAT TRANSFER COEFFICIENTS,/31X,18H(BAVERHT  11
     1TU/SQFT,HR,DEGF),//)                                              AVERHT  12
  300 KP=KP-1                                                           AVERHT  13
      KK=1                                                              AVERHT  14
      DO 73 JJJ=1,NNN                                                   AVERHT  15
      IF(KSURF(JJJ) .EQ. JSURF) GO TO 71                                AVERHT  16
   73 CONTINUE                                                          AVERHT  17
   71 IF(ICS .GT. 0) GO TO 200                                          AVERHT  18
      M=1                                                               AVERHT  19
      GO TO 72                                                          AVERHT  20
  200 DO 201 KU=1,ICS                                                   AVERHT  21
      IF(ICSURF(KU) .EQ. JSURF) GO TO 202                               AVERHT  22
  201 CONTINUE                                                          AVERHT  23
      M=0                                                               AVERHT  24
      GO TO 72                                                          AVERHT  25
  202 CALL STORE(HGAT,AT,JJJ,1)                                         AVERHT  26
      M=1                                                               AVERHT  27
   72 DO 6 J=1,N                                                        AVERHT  28
      IF(X(1) .LT. XU(J)) GO TO 7                                       AVERHT  29
    6 CONTINUE                                                          AVERHT  30
    7 J=J-1                                                             AVERHT  31
      DO 11 JJ=J,N                                                      AVERHT  32
      IF(M .GT. 0) GO TO 2                                              AVERHT  33
      HGAT=0.0                                                          AVERHT  34
      AT=0.0                                                            AVERHT  35
    2 DO 12 K=KK,KP                                                     AVERHT  36
      IF(X(K+1) .GT. XU(JJ+1)) GO TO 13                                 AVERHT  37
      XL=SQRT(((X(K)-X(K+1))*(X(K)-X(K+1)))+((Y(K)-Y(K+1))*(Y(K)-Y(K+1))AVERHT  38
     1))                                                                AVERHT  39
      A=3.14159*XL*(Y(K)+Y(K+1))                                        AVERHT  40
      HGA=(HG(K)+HG(K+1))/2.0                                           AVERHT  41
      HGAT=HGAT+(HGA*A)                                                 AVERHT  42
      AT=AT+A                                                           AVERHT  43
      DIFF=ABS(X(K+1)-XU(JJ+1))                                         AVERHT  44
      IF(DIFF .LT. 0.01) GO TO 50                                       AVERHT  45
      GO TO 11                                                          AVERHT  46
   50 HGOAT=HGAT/AT                                                     AVERHT  47
      IF(PRINT3 .EQ. 0) GO TO 301                                       AVERHT  48
      WRITE(6,100) NODE(JJJ,JJ),HGOAT,AT                                AVERHT  49
  100 FORMAT(34X,9HNODE NO. ,I2,/29X,15HHT COEFFICIENT ,F8.3,/26X,13HSURAVERHT  50
     1FACE AREA ,F8.3,7H (SQIN),/)                                      AVERHT  51
  301 LU=LU+1                                                           AVERHT  52
      NODE1(LU)=NODE(JJJ,JJ)                                            AVERHT  53
      HT1(LU)=HGAT/144.0                                                AVERHT  54
      M=J                                                               AVERHT  55
      IF(K .EQ. KP) GO TO 59                                            AVERHT  56
      KK=MIN0(KK+1,KP)                                                  AVERHT  57
      GO TO 10                                                          AVERHT  58
```

```
       13 XL=SQRT(((X(K)-XU(JJ+1))*(X(K)-XU(JJ+1)))+((Y(K)-YU(JJ+1))*(Y(K)-   AVERHT  59
         1YU(JJ+1))))                                                       AVERHT  60
          A=3.14159*XL*(Y(K)+YU(JJ+1))                                      AVERHT  61
          HGA=(HG(K)+HG(K+1))/2.0                                           AVERHT  62
          HGAT=HGAT+(HGA*A)                                                 AVERHT  63
          AT=AT+A                                                           AVERHT  64
          HGDAT=HGAT/AT                                                     AVERHT  65
          IF(PRINT3 .EQ. 0) GO TO 302                                       AVERHT  66
          WRITE(6,100) NODE(JJJ,JJ),HGDAT,AT                                AVERHT  67
      302 LU=LU+1                                                           AVERHT  68
          NODE1(LU)=NODE(JJJ,JJ)                                            AVERHT  69
          HT1(LU)=HGAT/144.0                                                AVERHT  70
          HGAT=0.0                                                          AVERHT  71
          AT=0.0                                                            AVERHT  72
          XL=SQRT(((Y(K+1)-YU(JJ+1))*(X(K+1)-XU(JJ+1)))+((Y(K+1)-YU(JJ+1))* AVERHT  73
         1(Y(K+1)-YU(JJ+1))))                                               AVERHT  74
          A=3.14159*XL*(Y(K+1)+YU(JJ+1))                                    AVERHT  75
          HGAT=HGAT+(HGA*A)                                                 AVERHT  76
          AT=AT+A                                                           AVERHT  77
          M=1                                                               AVERHT  78
          KK=MIN0(KK+1,KP)                                                  AVERHT  79
          GO TO 10                                                          AVERHT  80
       11 IF(X(KP+1) .LT. XU(JJ+1)) GO TO 40                                AVERHT  81
          GO TO 12                                                          AVERHT  82
       40 M=1                                                               AVERHT  83
          CALL STORE(HGAT,AT,JJJ,0)                                         AVERHT  84
          IF(K .EQ. KP) GO TO 60                                            AVERHT  85
       12 CONTINUE                                                          AVERHT  86
       11 CONTINUE                                                          AVERHT  87
       59 AT=0.0                                                            AVERHT  88
          HGAT=0.0                                                          AVERHT  89
          CALL STORE(HGAT,AT,JJJ,0)                                         AVERHT  90
       60 RETURN                                                            AVERHT  91
          END                                                               AVERHT  92
```

```
      SUBROUTINE HEAT(XI,XF,TTO,PTO,THET,HI,XT,YT,XMT,TWT,CTHETA,CHIA,     HEAT   2
     1X11,Y11,HT11,IKJ,       ISTREM,JSURF,ICSURF,ICS,IPRNT2,II,CF11)      HEAT   3
      DIMENSION CTHETA(1),CHIA(1)                                          HEAT   4
      DIMENSION X11(1),Y11(1),HT11(1),CF11(1)                              HEAT   5
      DIMENSION XT(1),YT(1),XMT(1),TWT(1),ICSURF(1)                        HEAT   6
      REAL MO,MUO,M1,NUO                                                   HEAT   7
      MO=M1=XMT(1)                                                         HEAT   8
      IF(THET) 50,51,51                                                    HEAT   9
   50 DO 53 J=1,ICS                                                        HEAT  10
      IF(JSURF-ICSURF(J)) 53,55,53                                         HEAT  11
   53 CONTINUE                                                             HEAT  12
   55 THET=CTHETA(J)                                                       HEAT  13
      HI=CHIA(J)                                                           HEAT  14
   51 THET=THET/12.0                                                       HEAT  15
      CHK=(XF-XI)                                                          HEAT  16
      KKP=CHK                                                              HEAT  17
      CHK1=KKP                                                             HEAT  18
      IF(CHK .EQ. CHK1) GO TO 300                                          HEAT  19
      KP=KKP+2                                                             HEAT  20
      GO TO 301                                                            HEAT  21
  300 KP=KKP+1                                                             HEAT  22
  301 KK=KP                                                                HEAT  23
      DO 100 I=1,KK                                                        HEAT  24
      XT(I)=XT(I)/12.0                                                     HEAT  25
  100 YT(I)=YT(I)/12.0                                                     HEAT  26
      XFIN=XF/12.0                                                         HEAT  27
      DX=0.08333333333333                                                  HEAT  28
      L=1                                                                  HEAT  29
      X1=XT(L)-DX                                                          HEAT  30
      KKKKK=0                                                              HEAT  31
 1000 CALL CPAGMA (MO,TTO,CP,GM)                                           HEAT  32
      KKKK=-1                                                              HEAT  33
      CG=(GM-1.)/2.                                                        HEAT  34
      HO=CP*TTO                                                            HEAT  35
      AO=41.4266*SQRT(GM*TTO)                                              HEAT  36
      RHOO=2.7*PTO/TTO                                                     HEAT  37
      MUO=(7.31E-07*TTO**1.5)/(TTO+198.6)                                  HEAT  38
      NUO=MUO/RHOO                                                         HEAT  39
      SM1=XMT(1)*XMT(1)                                                    HEAT  40
      H=HI*(1.0+CG*SM1)+CG*SM1                                             HEAT  41
      CALL TURBLT(XT,YT,XMT,TWT,X1,XFIN,TTO,PTO,AO,NUO,MUO,CG,HO,GM,DX,    HEAT  42
     1 M1,CP,THET,HI,H,CTHETA,CHIA,X11,Y11,HT11,IPRNT2,II,I,KK,KP,KKKK,    HEAT  43
     2 KKKKK,L,ISTREM,JSURF,ICSURF,ICS,IKJ,CF11)                           HEAT  44
      IF(KKKK)200,201,201                                                  HEAT  45
  201 THET=0.0001                                                          HEAT  46
      HI=1.3                                                               HEAT  47
      MO=M1                                                                HEAT  48
      GO TO 1000                                                           HEAT  49
  200 DO 500 I=1,KK                                                        HEAT  50
  500 XT(I)=XT(I)*12.0                                                     HEAT  51
      RETURN                                                               HEAT  52
      END                                                                  HEAT  53
```

```
      SUBROUTINE TURBLT(XT,YT,XMT,TMT,X1,    XF,TTO,PTO,AO,NUO,     MUO,
     1GG,    HO,         SM,DX,M1,CP,          THET,HI,H,
     2          CTHETA,CHIA,X11,Y11,HT11,PRINT2,II,I,KK,KP,KKKK,
     3KKKKK,L,ISTREK,JSURF,ICSURF,ICS,IKJ,CF11)
      DIMENSION CTHETA(1),CHIA(1)
      DIMENSION X11(1),Y11(1),HT11(1),CF11(1)
      DIMENSION XT(1),YT(1),XMT(1),TMT(1),ICSURF(1)
      REAL    MUO,M1,LAMBDA,MU1,NUO,M2,MUR,MU2
      INTEGER PRINT2
    5 FORMAT(///,6X,"BOUNDARY LAYER FLAT PLATE SHAPE FACTOR ITERATION FA
     1ILED TO CONVERGE.",/,25X,"PROGRAM EXECUTION IS STOPPED.",/,30X,"(S
     2UBROUTINE TURBLT)")
 4030 FORMAT(1H1,7X,1HX,9X,1HY,7X,4HMACH,7X,3HDEL,10X,4HSKIN,13X,2HHT,/5
     1X,5H(IN.),5X,5H(IN.),6X,2HNO,7X,5H(IN.),7X,8HFRICTION,4X,18H(BTU/S
     2QFT,HR,DEGF),/)
    7 FORMAT(1H1,/28X,16HFLOW STREAM NO. ,I1,26H HEAT TRANSFER INFORMATI
     1ON,/43X,12HSURFACE NO. ,I1,/)
   10 FORMAT(/7X,1HX,9X,1HY,7X,4HMACH,7X,3HDEL,13X,4HSKIN,13X,2HHT,/5X,5
     1H(IN.),5X,5H(IN.),6X,2HNO,7X,5H(IN.),7X,8HFRICTION,4X,18H(BTU/SQFT
     2,HR,DEGF),/)
   11 FORMAT(2(4X,F6.3),4X,F5.3,2(4X,F9.6),10X,F5.3/)
      DEL=0.0
      X2=X1
      Y2=YT(1)
      IF(KKKKK)5000,5001,5001
 5000 KKKKK=0
      GO TO 5002
 5001 IF(PRINT2 .EQ. 0) GO TO 7000
      WRITE(6,7) ISTREK,JSURF
      WRITE(6,10)
 7000 IKJ=0
      LINE=7
 5002 J=0
      KKK=-1
      E1=(GM+ 1.)/(2.*(GM-1.0))
  121 M2=0.0
  123 DO 25 I=L,KP
      TM=M1
      X1=X1+DX
      IF(X1-XF)131,50,50
   50 X1=XF
      L=KP+1
  131 CALL TABLEL (XT,XMT,X1,M1,DMDX,KK)
      CALL TABLEL (XT,YT,X1,Y1,DYDX,KK)
      IF(II .EQ. 1) DYDX=-DYDX
      IF(KKKK)3000,3001,3001
 3001 IF(TM-M1)3002,3002,3000
 3002 L=I
      X1=X1-DX
      KKKKK=-1
      RETURN
 3000 SM1=M1*M1
      Y1A=0.5*(Y2+Y1)
      IF (Y1A) 133,132,133
  132 Y1A=1.0
  133 TE1=TTO/(1.0+CG*SM1)
      CALL PRNCTL (TE1,PR)
```

```
      IF(KKKK)3006,3007,3007
 3007 CALL HEATTP(HT,CP,CF,PR,HI,M1,TTO,TE1,PTO,GM)
      LINE=LINE+2
      IF(LINE-60)3008,3008,3009
 3009 WRITE(6,4000)
      LINE=3
 3008 X1=X1*12.0
      Y1=Y1*12.0
      DEL=DEL*12.0
      WRITE(6,11) X1,Y1,M1,DEL,CF,HT
      IKJ=IKJ+1
      X11(IKJ)=X1
      Y11(IKJ)=Y1
      HT11(IKJ)=HT
      CF11(IKJ)=CF
      X1=X1/12.0
      Y1=Y1/12.0
      DEL=DEL/12.0
      GO TO 25
 3006 HX1= CP*TE1
      HAW=   (1.+CG*PR**.3333* SM1)*HX1
      CALL TABLEL (XT,TWT,X1,TW1,DTWDX,KK)
      IF(TW1) 14,14,15
   14 HW1=HAW
      TW1=HW1/CP
      GO TO 16
   15 HW1= CP*TW1
   16 TER= 0.5*TW1+.22*PR**.3333*TTO+(0.5-.22*PR**.3333)*TE1
      TER1=TER
      LAMBDA=(TTO+198.6)*SQRT(TW1/TTO)/(TW1+198.6)
      MU1=LAMBDA*TE1*MUO/TTO
      MUR=LAMBDA*TER*MUO/TTO
      W2=.5*( M1+ M2)*AO/ NUO
      W31= (TE1/TTO)**E1
      W41=( MUR/ MUO)**.268
      M1=(TTO/TER)*W31
      C1=SQRT(TE1/TTO)
      AE=41.4266*SQRT(GM*TE1)
      U1=M1*AE
      CU1=(.5*(U1+U2))/(.5*(C1+C2))
      IF (J-1) 181,19,19
  181 J=1
      IF (THET) 182,182,183
  183 IF (DEL) 1834,1834,1835
 1835 THETLM=THET
      DTRLM=DTR
      DO 1833 II=1,2
      VPLE=DTR
      DO 1931 III=1,50
      VPLET=DTR-3.0-2.0/VPLE
      IF (ABS((VPLET-VPLE)/VPLE)-.001) 1832,1832,1831
 1831 VPLE=VPLET
 1832 HI=(2.0+VPLE)/VPLE
      O-OI*(C...M1*(HI+1.))
      THET=DEL/O
 1833 DTR=DTRLM*THET/THETLM
 1834 H=CG*SM1*HW1*HI*(1.0+CG*SM1)/HO
```

```
      HIA=HI                                                            TURBLT   116
      THTRC=THET *W31                                                   TURBLT   117
      THTR =THTRC                                                       TURBLT   118
      CU1=U1/C1                                                         TURBLT   119
      A1=0.123*(TE1/TER)*W41/EXP(1.561*HIA)/((CU1*THTR / NUO)**.268)    TURBLT   120
      CF =2.0*A1                                                        TURBLT   121
      TE2=TE1                                                           TURBLT   122
      W3A=W31                                                           TURBLT   123
      W6=H41/HO                                                         TURBLT   124
      H2= H1                                                            TURBLT   125
      GO TO 201                                                         TURBLT   126
  182 HI =1.3                                                           TURBLT   127
      H=CG*SM1+HW1*HI*(1.+CG*SM1)/HO                                    TURBLT   128
      THET =0.0                                                         TURBLT   129
      THTR =0.0                                                         TURBLT   130
      DSTAR=0.0                                                         TURBLT   131
      CF=0.0                                                            TURBLT   132
      DEL=0.0                                                           TURBLT   133
      CU1= U1/C1                                                        TURBLT   134
      GO TO 26                                                          TURBLT   135
   19 DARC =SQRT((X1-X2)*(X1-X2)+(Y1-Y2)*(Y1-Y2))                       TURBLT   136
      DCS=.5*(B1+B2)*DARC                                               TURBLT   137
      TER=.5*(TER1+TER2)                                                TURBLT   138
      TEA=.5*(TE1+TE2)                                                  TURBLT   139
      W3A=.5*(W31+W32)                                                  TURBLT   140
      W4A=.5*(W41+W42)                                                  TURBLT   141
      W5=(CU1-CU2)/DCS/(.5*(CU1+CU2))                                   TURBLT   142
      W6=.5*(HW1+HW2)/HO                                                TURBLT   143
      CUA=.5*(CU1+CU2)                                                  TURBLT   144
      IF (THET ) 400,400,401                                            TURBLT   145
  400 THET =.036*DARC /(W2*DARC)**.2                                    TURBLT   146
  401 THTP=THET*W31                                                     TURBLT   147
      IF (DMDX) 2441,2442,2442                                          TURBLT   148
 2441 F1=1.+DMDX*DMDX                                                   TURBLT   149
      GO TO 2443                                                        TURBLT   150
 2442 F1=1.0                                                            TURBLT   151
 2443 F2=CP/(1.0+CG*SM1)                                                TURBLT   152
      IF (F1*F2-1.0) 2445,2445,2444                                     TURBLT   153
 2444 F1=1.0/F2                                                         TURBLT   154
 2445 THTRL=THTP                                                        TURBLT   155
      Y1A=Y1A+.72363*DEL                                                TURBLT   156
      DO 251 ITER=1,10                                                  TURBLT   157
      HIA=0.5*(HI2+HI)                                                  TURBLT   158
      DO 243 ITHETA=1,25                                                TURBLT   159
      THTRA=0.5*(THTR2+THTR)                                            TURBLT   160
      A1=0.123*(TEA/TER)*W4A/EXP(1.561*HIA)/((CUA*THTRA/NUO)**.268)     TURBLT   161
      DTD=A1*TER/TTO-THTRA*W5*(2.0+W6*HIA)-   THTRA*(Y1-Y2)/(Y1A*DCS)   TURBLT   162
      THTRC=THTP2+DTD*DCS                                               TURBLT   163
      IF (THTRC) 241,241,242                                            TURBLT   164
  241 THTRC=0.5*THTR                                                    TURBLT   165
      GO TO 243                                                         TURBLT   166
  242 IF (ABS((THTRC-THTR)/THTR)-.005) 244,244,243                      TURBLT   167
  243 THTR=THTRC                                                        TURBLT   168
  244 THTP=THTRC                                                        TURBLT   169
      DO 249 IHI=1,25                                                   TURBLT   170
      HIA=0.5*(HI2+HI)                                                  TURBLT   171
      IF(HIA-4.0   )1010,1010,1012                                      TURBLT   172
```

```
 1012 KKKK=0                                                         TURBLT 173
      THTRL=THTR                                                     TURBLT 174
      HIC=111.00                                                     TURBLT 175
      GO TO 252                                                      TURBLT 176
 1010 Q1=HIA*(HIA+1.0)*(HIA+1.0)*(HIA-1.0)                           TURBLT 177
      Q2=1.0+(W6-1.0)*(HIA*HIA+4.0*HIA-1.0)/((HIA+1.0)*(HIA+3.0))    TURBLT 178
      Q3=HIA*(HIA-1.0)*(HIA-1.0)*A1*TER/TTO/THTRA                    TURBLT 179
      Q4=(HIA*HIA-1.0)*(HIA+1.0)*(TER/TTO)*(.003075*HIA-.003352)/THTRA TURBLT 180
      Q4=F1*F2*Q4                                                    TURBLT 181
      Q5=0.5*W5*Q1*Q2                                                TURBLT 182
      OHO=Q3-Q4-Q5                                                   TURBLT 183
      HIC=HI2+OHO*DCS                                                TURBLT 184
      IF (HIC) 245,245,246                                           TURBLT 185
  245 HIC=1.0                                                        TURBLT 186
      GO TO 249                                                      TURBLT 187
  246 IF(HIC-2.5)1002,1002,248                                       TURBLT 188
 1002 KKK=-1                                                         TURBLT 189
      GO TO 247                                                      TURBLT 190
  248 IF(KKK)1000,247,247                                            TURBLT 191
 1000 KKK=0                                                          TURBLT 192
  247 IF(ABS((HIC-HI)/HI)-.005)250,250,249                           TURBLT 193
  249 HI=HIC                                                         TURBLT 194
      WRITE (6,5)                                                    TURBLT 195
      STOP                                                           TURBLT 196
  250 IF(ABS((THTRL-THTR)/THTR)-.005)252,252,251                     TURBLT 197
  251 THTRL=THTR                                                     TURBLT 198
  252 THET=THTR/W31                                                  TURBLT 199
      HI =HIC                                                        TURBLT 200
      CF=0.246*(TE1/TER)*W41/EXP(1.561*HI)/((CU1*THTR/NUO)**0.268)   TURBLT 201
  201 AMSQA=.5*( M1* M1+ M2* M2)                                     TURBLT 202
      H=CG*AMSQA+W6*HIA*(1.+CG*AMSQA)                                TURBLT 203
      THTP =THTRC                                                    TURBLT 204
      DSTAR=H*THET                                                   TURBLT 205
      AM=2.0/(HI-1.0)                                                TURBLT 206
      DTR=(2.0+AM)*(1.0+AM)/AM                                       TURBLT 207
      DEL=THET*(DTR+CG*AMSQA*(HI+1.0))                               TURBLT 208
   26 X2=X1                                                          TURBLT 209
      CALL HEATTR(HT,CP,CF,PR,HI,M1,TTO,TE1,PTO,GM)                  TURBLT 210
      Y2=Y1                                                          TURBLT 211
       M2= M1                                                        TURBLT 212
      TE2=TE1                                                        TURBLT 213
      HW2=HW1                                                        TURBLT 214
      TER2=TER1                                                      TURBLT 215
      THTR2=THTR                                                     TURBLT 216
      HI2=HI                                                         TURBLT 217
      R2=R1                                                          TURBLT 218
      C2=C1                                                          TURBLT 219
      U2=U1                                                          TURBLT 220
      CU2=CU1                                                        TURBLT 221
       MU2= MU1                                                      TURBLT 222
      W32=W31                                                        TURBLT 223
      W42=W41                                                        TURBLT 224
      IF(PRINT2 .EQ. 0) GO TO 502                                    TURBLT 225
      LINE=LINE+2                                                    TURBLT 226
      IF (LINE-60) 502,502,501                                       TURBLT 227
  501 WRITE(6,4000)                                                  TURBLT 228
      LINE=3                                                         TURBLT 229
```

```
  582 X1=X1*12.0                                                    TURBLT 230
      Y1=Y1*12.0                                                    TURBLT 231
      IF(PRINT2 .EQ. 0) GO TO 7001                                  TURBLT 232
      DEL=DEL*12.0                                                  TURBLT 233
      WRITE(6,11) X1,Y1,M1,DEL,CF,HT                                TURBLT 234
      DEL=DEL/12.0                                                  TURBLT 235
 7001 IKJ=IKJ+1                                                     TURBLT 236
      X11(IKJ)=X1                                                   TURBLT 237
      Y11(IKJ)=Y1                                                   TURBLT 238
      HT11(IKJ)=HT                                                  TURBLT 239
      CF11(IKJ)=CF                                                  TURBLT 240
      X1=X1/12.0                                                    TURBLT 241
      Y1=Y1/12.0                                                    TURBLT 242
      IF(L .GT. KP) GO TO 731                                       TURBLT 243
   25 CONTINUE                                                      TURBLT 244
  731 KKKK=-1                                                       TURBLT 245
      I=1                                                           TURBLT 246
      IF(ICS) 703,703,705                                           TURBLT 247
  705 DO 731 JAA=1,ICS                                              TURBLT 248
      IF(JSURF-ICSURF(JAA)) 701,702,701                             TURBLT 249
  702 CTHETA(JAA)=THET*12.0                                         TURBLT 250
      CHIA(JAA)=HI                                                  TURBLT 251
      GO TO 703                                                     TURBLT 252
  701 CONTINUE                                                      TURBLT 253
  703 RETURN                                                        TURBLT 254
      END                                                           TURBLT 255
```

```
      SUBROUTINE HEATTR(HT,CP,CF,PR,HI,M1,TTO,TE1,PTO,GM)              HEATTR   2
      REAL M1                                                           HEATTR   3
      GMR1=(GM+1.)/((2.*GM)-2.)                                         HEATTR   4
      GMR2=-GM/(GM-1.)                                                  HEATTR   5
      TR=TTO/TE1                                                        HEATTR   6
      SQM1=M1*M1                                                        HEATTR   7
      EXPP=1.561*(HI-(1.3*TR)-(SQM1/5.))                                HEATTR   8
      PRNO=PR**(-.6667)                                                 HEATTR   9
      HT=211428.972*CF*PTO*M1*CP*PRNO*(TE1**GMR1)*(TTO**GMR2)*EXP(EXPP) HEATTR  10
      RETURN                                                            HEATTR  11
      END                                                               HEATTR  12
```

```
      SUBROUTINE AVERFS(X,Y,CF,XU,YU,ICS,ICSURF,N,KP,JSURF,KSURF,NODE,
     1NNN,XMN,P,GAM,II,FPAT,FFT)
      DIMENSION X(1),Y(1),CF(1),XU(1),YU(1),KSURF(1),NODE(5,20),
     1ICSURF(1),XMN(1),P(1)
      COMMON/BBB/ NODE15(50),FT1(50),LU1
      KK=1
      DO 73 JJJ=1,NNN
      IF(KSURF(JJJ) .EQ. JSURF) GO TO 71
   73 CONTINUE
   71 IF(ICS .GT. 0) GO TO 200
      M=J
      GO TO 72
  200 DO 201 KU=1,ICS
      IF(ICSURF(KU) .EQ. JSURF) GO TO 202
  201 CONTINUE
      M=5
      GO TO 72
  202 CALL STORE1(FPAT,FFT,JJJ,1)
      M=1
   72 DO 6 J=1,N
      IF(X(1) .LT. XU(J)) GO TO 7
    6 CONTINUE
    7 J=J-1
      DO 11 JJ=J,N
      IF(M .GT. 0) GO TO 504
      FPAT=0.0
      FFT=0.0
  504 DEL=YU(JJ+1)-YU(JJ)
      TH=ATAN(ABS(DEL)/(XU(JJ+1)-XU(JJ)))
      STH=SIN(TH)
      CTH=COS(TH)
      IF(II .EQ. 2) GO TO 500
      IF(DEL-0.0) 501,502,503
  501 CDEL=+1.0
      GO TO 2
  502 CDEL=0.0
      GO TO 2
  503 CDEL=-1.0
      GO TO 2
  500 IF(DEL-0.0) 503,502,501
    2 DO 12 K=KK,KP
      IF(X(K+1) .GT. XU(JJ+1)) GO TO 13
      XL=SQRT(((X(K)-X(K+1))*(X(K)-X(K+1)))+((Y(K)-Y(K+1))*(Y(K)-Y(K+1))
     1))
      A=3.14159*XL*(Y(K)+Y(K+1))
      CFAV=(CF(K)+CF(K+1))/2.0
      PAV=(P(K)+P(K+1))/2.0
      XMNAV=(XMN(K)+XMN(K+1))/2.0
      FPAT=FPAT+(PAV*A)
      FFT=FFT+(PAV*A*CFAV*XMNAV*XMNAV*GAM/2.0)
      DIFF=ABS(X(K+1)-XU(JJ+1))
      IF(DIFF .LT. 0.01) GO TO 50
      GO TO 11
   50 FPATAV=FPAT*STH
      FFTAV=FFT*CTH
      FPATAV=FPATAV*CDEL
      FT=FFTAV+FPATAV
```

```
      LU1=LU1+1                                                          AVERFS
      JN=NODE(JJJ,JJ)                                                    AVERFS
      NODE15(JN)=JN                                                      AVERFS
      FT1(JN)=FT                                                         AVERFS
      M=0                                                                AVERFS
      IF(K .EQ. KP) GO TO 59                                             AVERFS
      KK=MIN0(KK+1,KP)                                                   AVERFS
      GO TO 10                                                           AVERFS
   13 XL=SQRT(((X(K)-XU(JJ+1))*(X(K)-XU(JJ+1)))+((Y(K)-YU(JJ+1))*(Y(K)- AVERFS
     1YU(JJ+1))))                                                        AVERFS
      A=3.14159*XL*(Y(K)+YU(JJ+1))                                       AVERFS
      CFAV=(CF(K)+CF(K+1))/2.0                                           AVERFS
      PAV=(P(K)+P(K+1))/2.0                                              AVERFS
      XMNAV=(XMN(K)+XMN(K+1))/2.0                                        AVERFS
      FPAT=FPAT+(PAV*A)                                                  AVERFS
      FFT=FFT+(PAV*A*CFAV*XMNAV*XMNAV*GAM/2.0)                           AVERFS
      FPATAV=FPAT*STH                                                    AVERFS
      FFTAV=FFT*CTH                                                      AVERFS
      FPATAV=FPATAV*CDEL                                                 AVERFS
      FT=FFTAV+FPATAV                                                    AVERFS
      LU1=LU1+1                                                          AVERFS
      JN=NODE(JJJ,JJ)                                                    AVERFS
      NODE15(JN)=JN                                                      AVERFS
      FT1(JN)=FT                                                         AVERFS
      FPAT=0.0                                                           AVERFS
      FFT=0.0                                                            AVERFS
      XL=SQRT(((X(K+1)-XU(JJ+1))*(X(K+1)-XU(JJ+1)))+((Y(K+1)-YU(JJ+1))*  AVERFS
     1(Y(K+1)-YU(JJ+1))))                                                AVERFS
      A=3.14159*XL*(Y(K+1)+YU(JJ+1))                                     AVERFS
      FPAT=FPAT+(PAV*A)                                                  AVERFS
      FFT=FFT+(PAV*A*CFAV*XMNAV*XMNAV*GAM/2.0)                           AVERFS
      M=1                                                                AVERFS
      KK=MIN0(KK+1,KP)                                                   AVERFS
      GO TO 10                                                           AVERFS
   11 IF(X(KP+1) .LT. XU(JJ+1)) GO TO 40                                 AVERFS
      GO TO 12                                                           AVERFS
   40 M=1                                                                AVERFS
      CALL STORE1(FPAT,FFT,JJJ,0)                                        AVERFS
      IF(K .EQ. KP) GO TO 60                                             AVERFS
   12 CONTINUE                                                           AVERFS
   10 CONTINUE                                                           AVERFS
   59 FPAT=0.0                                                           AVERFS
      FFT=0.0                                                            AVERFS
      CALL STORE1(FPAT,FFT,JJJ,0)                                        AVERFS
   60 RETURN                                                             AVERFS
      END                                                                AVERFS
```

```
      OVERLAY(XRHP,12,0)
      PROGRAM VIEW
      DIMENSION          YF(18,28),RF(18,28),YU(2),YO(2),RU(2),
     1 PO(2),VECT(2),DIV(2),NODE(2),A(2),PHIM(18),PHEO(23),PHICU(20),
     2 PHICL(20),PHIS(20),FHAM(18),PHILL(23),PHIUU(20),PHIMA(20),
     3 PHAMA(20),F(82,82),F1(63,63),FFSR(52,50)
      DIMENSION YUA(1),YDA(1),RUA(1),RDA(1),VECTA(1)
      DIMENSION YDUCT(4),RDUCT(4),ANGDUC(10),PHDU(10)
      DIMENSION ICFVO(50)
      COMMON/ALL/ M,NN,NSHB,ISURF(50),NODEA(55),JSURF(5,2),XF(5),NTOT,
     *            NOP,NP(10), ARE1(60)
      COMMON/PLM/QB(5000)
      COMMON /PRINT/ PRINT1, PRINT2, PRINT3, PRINT4, PRINT5,
     *               PRINT6, PRINT7, PRINT8, PRINT9, PRINT0
      COMMON/AAA/ YDUCT,RDUCT,IDUCT
      COMMON/HH/ X1,Y1,Z1,PHI1,R1,Y2,R2
       COMMON/OUT/ SPACE(61), ISTOPIT
      EQUIVALENCE (QB(1501),FFSR(1,1)), (QB(4001),YUA(1)),
     1 (QB(4056),RUA(1)), (QB(4111),YDA(1)), (QB(4166),RDA(1)),
     2  (QB(4221),VECTA(1)), (QB(4281),YF(1,1)), (QB(4681),RF(1,1))
         EQUIVALENCE(I1,JJ)
      INTEGER PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8
     1,PRINT9,PRINT0
      WRITE(6,12)
   12 FORMAT(1H1)
       PIE =3.141592653589793
      KOUNTR=0
      COUNTR=0
       CK1=SQRT(15.)/5.0
      NVERD=4
      ICDIV=2
         CDIV= ICDIV
         DUCT = IDUCT
      IF(IDUCT .EQ. 0) GO TO 15020
      DO 15011 I=1,NTOT
15011 ICFVO(I)=0
15020 LINET=4
      DO 13000 IUI=1,NTOT
      DO 15000 JUJ=IUI,NTOT
      DIV(1)=1.0
      DIV(2)=1.0
      YU(1)=YUA(IUI)
      YU(2)=YUA(JUJ)
      YD(1)=YDA(IUI)
      YD(2)=YDA(JUJ)
      RU(1)=RUA(IUI)
      RU(2)=RUA(JUJ)
      RD(1)=RDA(IUI)
      RD(2)=RDA(JUJ)
      VECT(1)=VECTA(IUI)
      VECT(2)=VECTA(JUJ)
      NODE(1)=NODEA(IUI)
      NODE(2)=NODEA(JUJ)
 5000 PHI1=0.0
         SHAD=0.0
 1140    IF( DUCT) 15,15,5
    5    CALL PICMAX(YDUCT,LDUMMY,NVERD,YMAXD)
```

```
      CALL PICMIN(YDUCT,LDUMMY,NVERD,YMIND)
      IF( YU(1)-YU(2)) 1100,1100,1105
 1100 YMINN= YU(1)
      GO TO 1110
 1105  YMINN= YU(2)
 1110 IF( YD(1)-YD(2)) 1115,1115,1120
 1115 YMAXN=YD(2)
      GO TO 1125
 1120  YMAXN=YD(1)
 1125 CALL TEST2(YMINN,YMAXN,YMIND,IFY)
      IF( IFY-1) 1130,1130,1135
 1135  CALL TEST2(YMINN,YMAXN,YMAXD,IFY)
       IF(IFY-1) 1130,1130,1145
 1145 CALL TEST2(YMIND,YMAXD,YMINN,IFY)
      IF(IFY-1) 1130,1130,1150
 1150 SHAD=0.0
      GO TO 15
 1130 SHAD=1.0
      PHIL= 2.*PIE/DUCT
      DPHI1 = PHIL/CDIV
      PHI1 = (.5-.5*CK1)*DPHI1
      ANGDUC(1)= PHIL
      IDUC= IDUCT-1
      DO 1155 JON=1,IDUC
      FJON = JON
 1155 ANGDUC(JON+1)= 2.*PIE*(FJON+1.0)/DUCT
   15 J=1
   A(J) = PIE*(RU(J) +RD(J))*SQRT((RD(J)-RU(J))**2 +(YD(J) -
     1  YU(J))**2)
   B1 =(YD(J)-YU(J))/SQRT((YD(J)-YU(J))**2 +(RD(J)-RU(J))**2)
   A1= -(RD(J)-RU(J))/SQRT((YD(J)-YU(J))**2 +(RD(J)-RU(J))**2)
     IF(VECT(J) ) 20,30,30
   20  B1 = -B1
     A1=  -A1
   30 IF(YD(J) -YU(J)) 32,34,32
   34  DR1 =( RD(J) -RU(J))/DIV(J)
      GO TO 36
   32 E1 =(RU(J)*YD(J)-RD(J)*YU(J))/(YD(J)-YU(J))
    H1 = (RD(J)-RU(J))/(YD(J)-YU(J))
      DY1 = (YD(J)-YU(J))/DIV(J)
   36 HYD1 = DIV(J)
      HYL = DIV(J)
  361 K=2
   A(K) = PIE*(RU(K)+RD(K))*SQRT((RD(K)-RU(K))**2 + (YD(K)-
     1  YU(K))**2)
   B2 =  (YD(K)-YU(K))/SQRT((YD(K)-YU(K))**2 + (RD(K)-RU(K))**2)
   A2 = -(RD(K)-RU(K))/SQRT((YD(K)-YU(K))**2 + (RD(K)-RU(K))**2)
    IF(VECT(K))40,50,50
   40 B2= -B2
    A2= -A2
      IF(YD(K) -YU(K)) 52,54,52
   54 DR2= (RD(K) -RU(K))/DIV(K)
      GO TO 56
   52 E2 =(RU(K)*YD(K)-RD(K)*YU(K))/(YD(K)-YU(K))
      F2 = (RD(K)-RU(K))/(YD(K)-YU(K))
      DY2 = (YD(K) -YU(K) )/DIV(K)
   56 FF=0.0
```

```
      NYD2 = DIV(K)
      LL=1
       LY = 1
      LP= 1
   77 SP1 =SIN(PHI1)
      CP1 =COS(PHI1)
      DO 603 L=1,NYD1
      PL = L
      IF(B1) 83,82,88
   88 YJ= YU(J) +(PL-1.)*DY1
      Y1 = DY1*(.5-.5*CK1)+YJ
   85 R1 = E1 + Y1*H1
      GO TO 87
   82 RJ = RU(J) +(PL-1.)*DR1
      R1 = RJ+DR1*(.5-.5*CK1)
      Y1 = YU(J)
   87 X1 = R1*CP1
    Z1= R1*SP1
      CA1 = B1*CP1
     CB1= A1
      CG1 = B1*SP1
     R=0.0
      MM=1
      DO 400 M=1,NYD2
      PM= M
      IF(B2) 88,89,88
   88 YK = YU(K)+(PM-1.)*DY2
      Y2 = YK+DY2*(.5-.5*CK1)
  405 R2 = E2 + F2*Y2
      GO TO 406
   89 RK = RU(K)+(PM-1.)*DR2
      R2 = RK+DR2*(.5-.5*CK1)
      Y2 = YU(K)
  406 IF(B2*R1) 66,65,66
   65 IF( B2*R2 +(Y2-Y1)*A2) 6605,6610,6605
   66 CP2P1 = P2/R1 + A2*(Y2-Y1)/(B2*R1)
      CALL ARCCOS(CP2P1,AP2P1,ITA1)
      IF(ITA1-1)70,70,6605
 6605 X2=R2*COS(PHI1+PIE/3.)
     Z2=R2*SIN(PHI1+PIE/3.)
      RHO2 = (X2-X1)**2+(Y2-Y1)**2+(Z2-Z1)**2
      IF(RHO2) 6610,6610,6615
 6610 GI=0.0
      GO TO 409
 6615 RHO=SQRT(RHO2)
      CST =(B2*R1*0.5-B2*R2+A2*(Y1-Y2))/RHO
      IF(CST) 6610,6610,6620
 6620 IND1 = 3
      GO TO 7001
   70 IF (-B2*SIN(AP2P1))  601,603,602
  603 CST = B2*R1*COS(AP2P1 + 0.174) -B2*R2 + A2*(Y1-Y2)
      IF(CST) 6610,6610,6620
  601 IND1 = 1
      GO TO 7001
  602 IND1 = 2
 7001 IF( B1*R2)  72,7010,72
 7010 IF( (Y2-Y1)*A1 -R1*B1) 7030,7040,7030
```

```
   72    DP2P1 = R1/R2 -A1*(Y2-Y1)/(B1*R2)                               VIEWS  173
         CALL APCCOS(DP2P1,BP2P1,ITA1)                                   VIEWS  174
         IF(ITA1-1)98,90,7030                                            VIEWS  175
 7030 X2=R2*COS(PHI1+PIE/3.)                                             VIEWS  176
      Z2=R2*SIN(PHI1+PIE/3.)                                             VIEWS  177
         RHO2 = (X2-X1)**2+(Y2-Y1)**2+(Z2-Z1)**2                         VIEWS  178
         IF(RHO2) 7040,7040,7050                                         VIEWS  179
 7040 GI=0.0                                                             VIEWS  180
         GO TO 409                                                       VIEWS  181
 7050 RHO = SQRT(RHO2)                                                   VIEWS  182
         CST = (R2*B1*0.5 -R1*B1 +(Y2-Y1)*A1)/RHO                        VIEWS  183
         IF(CST) 7040,7040,7060                                          VIEWS  184
 7060    IND2 = 3                                                        VIEWS  185
         GO TO 9001                                                      VIEWS  186
   90 IF  (-B1*SIN(BP2P1))  901,903,902                                  VIEWS  187
  903 CST = B1*R2*COS(BP2P1 + 0.174) - B1*R1+(Y2-Y1)*A1                  VIEWS  188
         IF(CST) 7040,7040,7060                                          VIEWS  189
  901    IND2 = 1                                                        VIEWS  190
         GO TO 9001                                                      VIEWS  191
  902    IND2 = 2                                                        VIEWS  192
 9001    GO TO(910,920,930), IND1                                        VIEWS  193
  910    GO TO(940,950,960),IND2                                         VIEWS  194
  920    GO TO(970,980,990), IND2                                        VIEWS  195
  930    GO TO(977,988,999),IND2                                         VIEWS  196
  940    IF(AP2P1-BP2P1) 941,941,942                                     VIEWS  197
  941 PHIL=0.0                                                           VIEWS  198
         PHIU= AP2P1                                                     VIEWS  199
       GO TO 98                                                          VIEWS  200
  942    PHIL= 0.0D+00                                                   VIEWS  201
         PHIU= BP2P1                                                     VIEWS  202
         GO TO 98                                                        VIEWS  203
  950    IF(AP2P1 -BP2P1)  9010,9010,9012                                VIEWS  204
 9010 GI=0.0                                                             VIEWS  205
         GO TO 409                                                       VIEWS  206
 9012    PHIU = AP2P1                                                    VIEWS  207
         PHIL= BP2P1                                                     VIEWS  208
         GO TO 98                                                        VIEWS  209
  960    PHIU = AP2P1                                                    VIEWS  210
      PHIL=0.0                                                           VIEWS  211
         GO TO 98                                                        VIEWS  212
  970    IF(AP2P1 -BP2P1) 9014,9010,9010                                 VIEWS  213
 9014    PHIL= AP2P1                                                     VIEWS  214
         PHIU = BP2P1                                                    VIEWS  215
         GO TO 98                                                        VIEWS  216
  980    IF(AP2P1 -BP2P1)  9018,9018,9020                                VIEWS  217
 9018    PHIL = BP2P1                                                    VIEWS  218
         PHIU=PIE                                                        VIEWS  219
         GO TO 98                                                        VIEWS  220
 9020    PHIL = AP2P1                                                    VIEWS  221
         PHIU = PIE                                                      VIEWS  222
         GO TO 98                                                        VIEWS  223
  999    PHIU = PIE                                                      VIEWS  224
         PHIL = AP2P1                                                    VIEWS  225
         GO TO 98                                                        VIEWS  226
  977 PHIL=0.0                                                           VIEWS  227
         PHIU = BP2P1                                                    VIEWS  228
         GO TO 98                                                        VIEWS  229
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  988 PHIL= BP2P1                                          VIEWS 230
      PHIU = PIE                                           VIEWS 231
      GO TO 98                                             VIEWS 232
  999 PHIL = 0.0                                           VIEWS 233
      PHIU= PIE                                            VIEWS 234
   98 IF(NSHB) 9940,9940,9801                              VIEWS 235
 9840    IF( SHAD) 2250,2250,9841                          VIEWS 236
 9841 LUCK=0                                               VIEWS 237
      GO TO 2240                                           VIEWS 238
 9801 LUKE= 0                                              VIEWS 239
      LARRY= 0                                             VIEWS 240
      LUCK= 0                                              VIEWS 241
      DO 1295  II=1,NSHB                                   VIEWS 242
      CALL FINDIT(Y1,YF,II,NP(II),NY1)                     VIEWS 243
      CALL FINDIT(Y2,YF,II,NP(II),NY2)                     VIEWS 244
      CALL CODE(NY1,NY2,NP(II),IC)                         VIEWS 245
   IF (ABS(Y1-Y2)-1.0E-3)  1240,1240,1250                  VIEWS 246
 1240 IF(IC-8)1900,1295,1295                               VIEWS 247
 1900 RFU= RF(JJ,NY1)                                      VIEWS 248
      YFU= YF(JJ,NY1)                                      VIEWS 249
      RFD= RF(JJ,NY1+1)                                    VIEWS 250
      YFD= YF(JJ,NY1+1)                                    VIEWS 251
      EF=(RFU*YFD -RFD*YFU)/(YFD-YFU)                      VIEWS 252
      FFF=(RFD-RFU)/(YFD-YFU)                              VIEWS 253
      RC1= EF+ FFF*Y1                                      VIEWS 254
   IF (ABS(RC1-R1) -1.0E-3) 1295,1295,1920                 VIEWS 255
 1920 IF (ABS(RC1-R2) -1.0E-3) 1295,1295,1930              VIEWS 256
 1930 IF(R1-RC1)  1950,1940,1940                           VIEWS 257
 1940  IF(R2-RC1) 7130,1970,1970                           VIEWS 258
 1950 IF(R2-RC1) 1295,1295,7130                            VIEWS 259
 1970 AAF=1.0                                              VIEWS 260
      BBF= -2.*RC1**2/(R1*R2)                              VIEWS 261
      CCF= RC1**2*(R2**2+R1**2)/(R1*R2)**2  -1.0           VIEWS 262
      CALL QUAD(AAF,BBF,CCF,RR11,RI11,RR22,RI12,IOR1)      VIEWS 263
      GO TO (1980,2000,1295,1295),IOR1                     VIEWS 264
 1980 CALL ARCCOS(RR22,FHIO,ITA1)                          VIEWS 265
      IF(ITA1-1) 1990,1990,2000                            VIEWS 266
 1990 CALL TEST1(R1,R2,FHIO,PHI1,X1,Z1,ITS1)               VIEWS 267
      IF(ITS1-1) 2030,2030,2000                            VIEWS 268
 2000 CALL ARCCOS(RR11,FHIO,ITA1)                          VIEWS 269
      IF( ITA1-1) 2010,2010,1295                           VIEWS 270
 2010 CALL TEST1(R1,R2,FHIO,PHI1,X1,Z1,ITS1)               VIEWS 271
      IF(ITS1-1) 2030,2030,1295                            VIEWS 272
 2030  LUKE=LUKE+1                                         VIEWS 273
      PHIM(LUKE) = FHIO                                    VIEWS 274
       GO TO 1295                                          VIEWS 275
 1250 GO TO(1260,1265,1270,1275,1280,1285,1260,1295),IC    VIEWS 276
 1260 KI = 1                                               VIEWS 277
      KIL= NP(II) -1                                       VIEWS 278
      GO TO 1300                                           VIEWS 279
 1265 KI=1                                                 VIEWS 280
       KIL = NY2                                           VIEWS 281
      GO TO 1300                                           VIEWS 282
 1270 KI=1                                                 VIEWS 283
      KIL= NY1                                             VIEWS 284
         GO TO 1300                                        VIEWS 285
 1275 KI=NY1                                               VIEWS 286
```

```
      KIL= NP(II)-1
      GO TO 1300
 1280 IF(Y1-Y2) 1310,1310,1315
 1310 KI=NY1
      KIL = NY2
      GO TO 1300
 1315 KI= NY2
      KIL= NY1
      GO TO 1300
 1285 KI= NY2
      KIL= NP(II) -1
 1300  CALL CANSEE(Y1,R1,Y2,R2,YF,RF,KI,KIL,II,ISEE)
      GO TO (1295,1399,1699,7130,1399),ISEE
 1399 LUM= 0
      DO 1400  LOLA= KI,KIL
      IF(Y1-Y2) 1420,1420,1410
 1410 KILE=KIL-(LOLA-KI)
      KILEP = KILE+1
      RFU=RF(JJ,KILE)
      RFD =RF(JJ,KILEP)
      YFU= YF(JJ,KILE)
      YFD= YF(JJ,KILEP)
      GO TO 1540
 1420 RFU=RF(JJ,LOLA)
      RFD= RF(JJ,LOLA+1)
       YFU=  YF(JJ,LOLA)
      YFD= YF(JJ,LOLA+1)
      IF(LOLA-KI) 1430,1430,1440
 1430 IF(Y1-YFU) 1450,1460,1460
 1450 CALL RING( Y1,R1,Y2,R2,YFU,RFU,ANG,LOIS)
      IF(LOIS-3) 1460,1465,1470
 1470 LUM= LUM+1
      PHEO(LUM)= ANG
      GO TO 1460
 1465  WRITE(6,1467)
 1467 FORMAT(1H1,/////,9X,"THE ANGLE FOR THE LIMIT OF INTEGRATION IS UND
     1EFINED.",/,25X,"THE COSINE IS GREATER THAN 1.",/,25X,"PROGRAM EXEC
     2UTION IS STOPPED.",/,30X,"(SUBROUTINE RING)")
     STOP
 1440 IF( LOLA-KIL) 1460,1480,1480
 1460 IF(Y2-YFD) 1490,1490,1462
 1462 CALL RING(Y1,R1,Y2,R2,YFD,RFD,ANG,LOIS)
      GO TO(1490,1490,1495,1500),LOIS
 1495 WRITE(6,1467)
     STOP
 1500 LUM=LUM+1
      PHEO(LUM)= ANG
 1490  CALL BODY(Y1,Y2,R1,R2,YFU,RFU,YFD,RFD,PHIO,PHI1,ION)
 1525  IF(ION-2) 1400,1510,1400
 1510  LUM=LUM+1
      PHEO(LUM) = PHIO
      GO TO 1400
 1480 IF(Y2-YFD) 1515,1515,1520
 1520  CALL RING(Y1,R1,Y2,R2,YFD,RFD,ANG,LOIS)
     GO TO(1515,1400,1495,1530),LOIS
 1530 LUM=LUM+1
      PHEO(LUM) =ANG
```

```
 1515 CALL BODY(Y1,Y2,R1,R2,YFU,RFU,YFD,RFD,PHIO,PHI1,ION)        VIEW$
        GO TO 1525                                                VIEW$
 1540   IF(LOLA-KI) 1550,1550,1545                                VIEW$
 1550   IF(Y1-YFD) 1560,1560,1555                                 VIEW$
 1555   CALL RING(Y1,R1,Y2,R2,YFD,RFD,ANG,LOIS)                   VIEW$
        IF(LOIS-3) 1560,1465,1565                                 VIEW$
 1565   LUM= LUM+1                                                VIEW$
        PHEO(LUM)=ANG                                             VIEW$
 1560   IF(Y2-YFU) 1562,1580,1580                                 VIEW$
 1562   CALL RING(Y1,R1,Y2,R2,YFU,RFU,ANG,LOIS)                   VIEW$
        GO TO(1580,1400,1495,1570),LOIS                           VIEW$
 1570   LUM=LUM+1                                                 VIEW$
        PHEO(LUM)= ANG                                            VIEW$
 1580 CALL BODY(Y1,Y2,R1,R2,YFU,RFU,YFD,RFD,PHIO,PHI1,ION)        VIEW$
        GO TO 1525                                                VIEW$
 1545    IF(LOLA-KIL) 1560,1585,1585                              VIEW$
 1585   IF(Y2-YFU) 1590,1595,1595                                 VIEW$
 1590   CALL RING(Y1,R1,Y2,R2,YFU,RFU,ANG,LOIS)                   VIEW$
         GO TO(1595,1400,1495,1600),LOIS                          VIEW$
 1600   LUM=LUM+1                                                 VIEW$
        PHEO(LUM)= ANG                                            VIEW$
 1595 CALL BODY(Y1,Y2,R1,R2,YFU,RFU,YFD,RFD,PHIO,PHI1,ION)        VIEW$
        GO TO 1525                                                VIEW$
 1400   CONTINUE                                                  VIEW$
        IF(LUM-1) 1295,1601,1601                                  VIEW$
 1601   IF(ISEE-5) 1603,1602,1602                                 VIEW$
 1602   CALL PICMAX(PHEO,LUCK,LUM,PHI4)                           VIEW$
        PHICU(LUCK) = PHI4                                        VIEW$
        LUCK= LUCK-1                                              VIEW$
        CALL PICMIN(PHEO,LUCK,LUM,PHI4)                           VIEW$
        PHICL(LUCK) =PHI4                                         VIEW$
        GO TO 1295                                                VIEW$
 1603   CALL PICMIN(PHEO,LUKE,LUM,PHI5)                           VIEW$
        PHIM(LUKE) = PHI5                                         VIEW$
        GO TO 1295                                                VIEW$
 1599   LIM=0                                                     VIEW$
        DO 1700 NELL= KI,KIL                                      VIEW$
        IF(Y1-Y2) 1720,1720,1710                                  VIEW$
 1710   MILE= KIL-(NELL-KI)                                       VIEW$
        MILEP= MILE+1                                             VIEW$
        RFU= RF(JJ,MILE)                                          VIEW$
        RFD= RF(JJ,MILEP)                                         VIEW$
        YFU = YF(JJ,MILE)                                         VIEW$
        YFD = YF(JJ,MILEP)                                        VIEW$
         GO TO 1840                                               VIEW$
 1720   RFU= RF(JJ,NELL)                                          VIEW$
        RFD= RF(JJ,NELL+1)                                        VIEW$
        YFU= YF(JJ,NELL)                                          VIEW$
        YFD= YF(JJ,NELL+1)                                        VIEW$
        IF(NELL-KI) 1730,1730,1760                                VIEW$
 1730   IF(Y1-YFU)1750,1760,1760                                  VIEW$
 1750   CALL RING(Y1,R1,Y2,R2,YFU,RFU,ANG,LOIS)                   VIEW$
        IF(LOIS-3) 1760,1765,1770                                 VIEW$
 1770   LIM=LIM+1                                                 VIEW$
        PHIS(LIM) = ANG                                           VIEW$
        GO TO 1760                                                VIEW$
 1765   WRITE(6,1477)                                             VIEW$
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```
      STOP
 1780 IF(Y2-YFD) 1700,1700,1762
 1762 CALL RING(Y1,R1,Y2,R2,YFD,RFD,ANG,LOIS)
      GO TO(1780,1760,1795,1880),LOIS
 1795 WRITE(6,1467)
      STOP
 1880 LIM=LIM+1
      PHIS(LIM) = ANG
      GO TO 1700
 1840 IF(NELL-KI) 1850,1850,1860
 1850 IF(Y1-YFD) 1860,1860,1855
 1855 CALL RING(Y1,R1,Y2,R2,YFD,RFD,ANG,LOIS)
      IF(LOIS-3) 1860,1765,1865
 1865 LIM= LIM+1
      PHIS(LIM)= ANG
 1860 IF(Y2-YFU) 1862,1700,1700
 1862 CALL RING(Y1,R1,Y2,R2,YFU,RFU,ANG,LOIS)
      GO TO(1700,1700,1795,1870),LOIS
 1870 LIM=LIM+1
      PHIS(LIM)= ANG
 1700 CONTINUE
      IF(LIM-1) 1295,1875,1875
 1875 CALL PICMAX(PHIS,LARRY,LIM,PHI6)
      PHAM(LARRY) = PHI6
 1295 CONTINUE
      IF(LUKE-1) 2160,2110,2110
 2110 CALL PICMIN(PHIM,LUKE,LUKE,PHIOUT)
      IF(LARRY-1) 2120,2130,2130
 2120 PHISL=0.0
      PHISU= PHIOUT
      GO TO 2140
 2130 CALL PICMAX(PHAM,LARRY,LARRY,PHIIN)
      IF(PHIOUT-PHIIN) 7130,7130,2150
 2150 PHISL=PHIIN
      PHISU=PHIOUT
      GO TO 2140
 2100 IF(LARRY-1) 2225,2160,2160
 2160 CALL PICMAX(PHAM,LARRY,LARRY,PHIIN)
      PHISL=PHIIN
      PHISU= PIE
 2140 IF(PHIU-PHISL) 7130,7130,2180
 2180 IF(PHISU-PHIL) 7130,7130,2190
 2190 IF(PHISL-PHIL) 2210,2210,2200
 2200 PHIL= PHISL
 2210 IF(PHISU-PHIU) 2220,2225,2225
 2220 PHIU= PHISU
 2225 IF(SHAD) 2230,2230,2240
 2240 JON =1
 2670 JACKL= NVERD-1
      DUCANG= ANGDUC(JON)
      LOUC= 0
      DO 2600  JACK=1,JACKL
      YOU1= YDUCT(JACK)
      YOU2= YDUCT(JACK+1)
      ROU1= RDUCT(JACK)
      ROU2= RDUCT(JACK+1)
      IF(IVEUE .EQ. 1) ICFVD(IUI)=1
```

```
      IF(IRENE-1) 2610,2610,2680                                        VIEW$
 2610 LOUC= LOUC+1                                                      VIEW$
      PHOU(LOUC) = PHIX                                                 VIEW$
 2680 CONTINUE                                                          VIEW$
      YOU1= YDUCT(NVERD)                                                VIEW$
      YOU2= YDUCT(1)                                                    VIEW$
      ROU1= RDUCT(NVERD)                                                VIEW$
      ROU2= RDUCT(1)                                                    VIEW$
    IF(IRENE .EQ. 1) ICFVD(IUI)=1                                       VIEW$
      IF(IRENE-1) 2620,2620,2630                                        VIEW$
 2620 LOUC= LOUC+1                                                      VIEW$
      PHOU(LOUC)= PHIY                                                  VIEW$
 2630 IF(LOUC-1) 2640,2650,2650                                         VIEW$
 2650 CALL PICMAX(PHOU,LUCK,LOUC,PHI7)                                  VIEW$
      PHICU(LUCK)= PHI7                                                 VIEW$
      LUCK=LUCK-1                                                       VIEW$
      CALL PICMIN(PHOU,LUCK,LOUC,PHI7)                                  VIEW$
      PHICL(LUCK)= PHI7                                                 VIEW$
      IF(PHICU(LUCK)- PHIU) 2640,2230,2230                              VIEW$
 2640 IF(JON-IDUCT) 2680,2230,2230                                      VIEW$
 2680 JON= JON+1                                                        VIEW$
      IF(  (ANGDUC(JON)-PHI1) -PIE) 2670,2670,2230                      VIEW$
 2230 IF(LUCK-1)  2250,2260,2250                                        VIEW$
 2250 ICIN=1                                                            VIEW$
      PHILL(1) = PHIL                                                   VIEW$
      PHIUU(1) = PHIU                                                   VIEW$
      GO TO 2270                                                        VIEW$
 2240 LUCKM= LUCK-1                                                     VIEW$
      DO 2290 IPH=1,LUCKM                                               VIEW$
      IPH1= IPH+1                                                       VIEW$
      DO 2290 JPH= IPH1,LUCK                                            VIEW$
      IF( PHICL(IPH)-PHICL(JPH)) 2290,2290,2300                         VIEW$
 2300 TEMP= PHICL(IPH)                                                  VIEW$
      PHICL(IPH) = PHICL(JPH)                                           VIEW$
      PHICL(JPH) = TEMP                                                 VIEW$
      TEMP= PHICU(IPH)                                                  VIEW$
      PHICU(IPH)= PHICU(JPH)                                            VIEW$
      PHICU(JPH) = TEMP                                                 VIEW$
 2290 CONTINUE                                                          VIEW$
 2260 LOCK= 1                                                           VIEW$
      PHIMA(LOCK) = PHICL(1)                                            VIEW$
      PHAMA(LOCK) = PHICU(1)                                            VIEW$
      JG= 2                                                             VIEW$
 2370 IF(JG-LUCK) 2320,2320,2330                                        VIEW$
 2320 CALL TEST2(PHIMA(LOCK),PHAMA(LOCK),PHICL(JG),IFP)                 VIEW$
      IF(IFP-1) 2340,2340,2350                                          VIEW$
 2340 CALL TEST2(PHIMA(LOCK),PHAMA(LOCK),PHICU(JG),IFP)                 VIEW$
      IF(IFP-1) 2360,2360,2380                                          VIEW$
 2380  PHAMA(LOCK) = PHICU(JG)                                          VIEW$
 2360 JG=JG+1                                                           VIEW$
      GO TO 2370                                                        VIEW$
 2350 LOCK=LOCK+1                                                       VIEW$
      PHIMA(LOCK) = PHICL(JG)                                           VIEW$
      PHAMA(LOCK) = PHICU(JG)                                           VIEW$
      GO TO 2360                                                        VIEW$
 2330 ICIN=0                                                            VIEW$
      JI=1                                                              VIEW$
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```
      PHILL(1)=PHIL
 2390 IF(JI-LOCK) 2410,2410,2400
 2400 PHIUU(1)= PHIU
      ICIN=1
      GO TO 2270
 2410 IF(PHIMA(JI)-PHIL) 2440,2440,2430
 2440 IF(PHAMA(JI)-PHIL) 2460,2450,2450
 2450 IF(PHAMA(JI)-PHIU) 2480,7130,7130
 2460 JI=JI+1
      GO TO 2390
 2430 IF(PHIMA(JI)-PHIU) 2432,2431,2431
 2431 PHIUU(1)= PHIU
      ICIN=1
      GO TO 2470
 2432 PHIUU(1) = PHIMA(JI)
      ICIN= 1
 2470 IF( PHAMA(JI)-PHIU) 2480,2270,2270
 2480 ICIN= ICIN+1
      PHILL(ICIN) = PHAMA(JI)
      IF(JI -LOCK) 2490,2500,2500
 2490 JI= JI+1
      IF(PHIU-PHIMA(JI) ) 2500,2500,2510
 2510 PHIUU(ICIN) = PHIMA(JI)
      GO TO 2470
 2500 PHIUU(ICIN) = PHIU
 2270  C= R2**2 + R1**2 + (Y2-Y1)**2
     D = 2. *R2*R1
      CMD = C - D
      SPECC=0.0
    IF(CMD-1.0E-5)  7070,7070,99
 7070 IF(R1) 7130,7130,7090
 7090 SPECC=1.0
      GI=0.0
      GO TO 7145
   99 CPD=C+D
      IF(CPD) 7130,7130,7140
 7130 GI=0.0
      GO TO 409
 7140 Q1=CPD/CMD
     Q2 = CMD/CPD
    SQ1 = SQRT(Q1)
    SQ2 = SQRT(Q2)
     Q3 = 2. *C/( CPD * CMD**2)
      Q4 = 2. * D/( CPD* CMD**2)
    EI20=0.0
 7145 DO 150 JA=1,ICIN
      PHIU = PHIUU(JA)
      PHIL = PHILL(JA)
      IF(SPECC) 7150,7150,7160
 7150 IF(  PHIU -PIE) 100,110,110
  100 SU2 = SIN(PHIU/2.)
    CU2 = COS(PHIU/2.)
      TU2 = SU2/CU2
      ATU2 = SQ1 *TU2
    AU = ATAN(ATU2)
      QSU = TU2/(1.+ Q1*TU2*TU2)
      GO TO 120
```

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  110    AU = PIE/2.
      Q5U=0.0
  120    IF(PHIL) 135,135,130
  130 SL2 = SIN(PHIL/2.)
      CL2 = COS(PHIL/2.)
         TL2 = SL2/CL2
         ATL2 = SQ1*TL2
      AL  =ATAN(ATL2)
         Q5L = TL2/(1. + Q1*TL2*TL2 )
         GO TO 140
  135 AL=0.0
      Q5L=0.0
  140    EI1 = SQ2*Q3*(AU -AL) + Q4*(Q5U-Q5L)
         EI2 = SQ2*Q4*(AU-AL) + Q3*(Q5U-Q5L)
         EI4 =( 1./D**2)*(PHIU -PHIL) +(Q3*(2.*D*D -C*C)/D**2)*SQ2*(AU-
     1 AL) +(Q3*C/D)*(Q5U-Q5L)
         CI1 = B1*B2*R1*R2
         CI2 = B2*A1*R1*(Y2-Y1)-B1*B2*R1*R1-B1*B2*R2*R2-B1*A2*R2*(Y2-Y1)
         CI3=B1*B2*R1*R2-B2*A1*R2*(Y2-Y1)+B1*A2*R1*(Y2-Y1)-A1*A2*(Y2-Y1)
     1   **2
         EI20 = CI1*EI4+CI2*EI2+CI3*EI1+EI20
         GO TO 150
 7160 GI=GI+ABS(B1)*(PHIU-PHIL)/(2.*PIE*R1)
  150    CONTINUE
         IF(SPECC) 299,299,409
  299    IF(B2) 310,300,310
  300    GI = 2.*R2*EI20/PIE
         GO TO 409
  310 GI=2.*R2*EI20/(PIE*ABS(B2))
  409    GO TO(410,420,430),MM
  410    GL=GI
         MM= 2
         IF(B2)  414,416,414
  416    R2=RK+DR2/2.
         GO TO 406
  414    Y2=YK+DY2/2.
         GO TO 405
  420    GM = GI
         MM=3
         IF(B2) 424,426,424
  426    R2=RK+DR2*(.5+.5*CK1)
         GO TO 406
  424    Y2=YK+DY2*(.5+.5*CK1)
         GO TO 405
  430    GR =GI
         MM=1
         IF(B2) 434,436,434
  436    R=R+(DR2/18.)*(5.*GL+8.*GM+5.*GR)
         GO TO 400
  434    R= R+(DY2/18.)*(5.*GL+8.*GM+5.*GR)
  400    CONTINUE
         IF(SHAD) 450,450,510
  450    IF(B1) 452,454,452
  452    GO TO(470,480,490),LL
  454    GO TO (472,482,492),LL
  470 RL = R*R1/ABS(B1)
         Y1= YJ+DY1/2.
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      LL=2                                                              VIEWS 629
      GO TO 85                                                          VIEWS 630
  472 RL = R*R1                                                         VIEWS 631
      R1 = RJ+DR1/2.                                                    VIEWS 632
      LL=2                                                              VIEWS 633
      GO TO 87                                                          VIEWS 634
  488 RM=R*R1/ABS(B1)                                                   VIEWS 635
      Y1=YJ+DY1*(.5+.5*CK1)                                             VIEWS 636
      LL=3                                                              VIEWS 637
      GO TO 85                                                          VIEWS 638
  482 RM= R*R1                                                          VIEWS 639
      R1=RJ+DR1*(.5+.5*CK1)                                             VIEWS 640
      LL=3                                                              VIEWS 641
      GO TO 87                                                          VIEWS 642
  498 RR=R*R1/ABS(B1)                                                   VIEWS 643
      FF=FF+(DY1/18.)*(5.*RL+8.*RM+5.*RR)                               VIEWS 644
      LL=1                                                              VIEWS 645
      GO TO 500                                                         VIEWS 646
  492 RR=R*R1                                                           VIEWS 647
      FF=FF+(DR1/18.)*(5.*RL+8.*RM+5.*RR)                               VIEWS 648
      LL=1                                                              VIEWS 649
      GO TO 500                                                         VIEWS 650
  510 IF(B1) 512,514,512                                                VIEWS 651
  512 GO TO(520,530,540),LL                                             VIEWS 652
  514 GO TO(522,532,542),LL                                             VIEWS 653
  520 F1(LY,LP) = R*R1/ABS(B1)                                          VIEWS 654
      Y1=YJ+DY1/2.                                                      VIEWS 655
      LL=2                                                              VIEWS 656
      LY=LY+1                                                           VIEWS 657
      GO TO 85                                                          VIEWS 658
  522 F1(LY,LP) = R*R1                                                  VIEWS 659
      R1=RJ+DR1/2.                                                      VIEWS 660
      LL=2                                                              VIEWS 661
      GO TO 87                                                          VIEWS 662
  530 F1(LY,LP) = R*R1/ABS(B1)                                          VIEWS 663
      Y1= YJ+DY1*(.5+.5*CK1)                                            VIEWS 664
      LL=3                                                              VIEWS 665
      LY = LY+1                                                         VIEWS 666
      GO TO 85                                                          VIEWS 667
  532 F1(LY,LP) = R*R1                                                  VIEWS 668
      R1=RJ+DR1*(.5+.5*CK1)                                             VIEWS 669
      LL=3                                                              VIEWS 670
      LY = LY+1                                                         VIEWS 671
      GO TO 87                                                          VIEWS 672
  540 F1(LY,LP) = R*R1/ABS(B1)                                          VIEWS 673
  541 LL=1                                                              VIEWS 674
      LY=LY+1                                                           VIEWS 675
      GO TO 500                                                         VIEWS 676
  542 F1(LY,LP) = R*R1                                                  VIEWS 677
      GO TO 541                                                         VIEWS 678
  500 CONTINUE                                                          VIEWS 679
      IF(SHAD) 620,620,550                                              VIEWS 680
  550 IF(LP -2) 560,570,580                                             VIEWS 681
  560 LP =2                                                             VIEWS 682
      PHI1 = PHI1+.5*CK1*DPHI1                                          VIEWS 683
      LY =1                                                             VIEWS 684
      GO TO 77                                                          VIEWS 685
```

```
  578    LP =3                                                               VIEWS
         PHI1= PHI1+ .5*CK1*DPHI1                                            VIEWS
         LY = 1                                                              VIEWS
         GO TO 77                                                            VIEWS
  588    DO 590  NN= 1,NYL                                                   VIEWS
         NM=3*NN-2                                                           VIEWS
         NM1= 3*NN-1                                                         VIEWS
         NM2=3*NN                                                            VIEWS
         FG=(DPHI1*25./324.)*(F1(NM,1)+F1(NM,3)+F1(NM2,1)+F1(NM2,3))         VIEWS
      1 + (DPHI1/8.1)*(F1(NM1,1)+F1(NM1,3)+F1(NM,2)+F1(NM2,2) ) +            VIEWS
      2  (DPHI1*64./324.)*(F1(NM1,2))                                        VIEWS
         IF(B1) 582,584,582                                                  VIEWS
  582    FF=FF+FG*DY1                                                        VIEWS
         GO TO 590                                                           VIEWS
  584    FF= FF+FG*DR1                                                       VIEWS
  590    CONTINUE                                                            VIEWS
         LL=1                                                                VIEWS
         LY=1                                                                VIEWS
         LP = 1                                                              VIEWS
         PHI1= PHI1+(1.-CK1)*DPHI1                                           VIEWS
        IF(ABS(PHI1-PHIL)-1.0E-2)    630,630,607                             VIEWS
  607      IF(PHI1-PHIL) 77,630,638                                          VIEWS
  628    F(J,K)= FF*2.*PIE/A(J)                                              VIEWS
         F(K,J)= F(J,K)*A(J)/A(K)                                            VIEWS
         GO TO 642                                                           VIEWS
  630    F(J,K)= FF*DUCT/A(J)                                                VIEWS
         F(K,J) = FF*DUCT/A(K)                                               VIEWS
  642 IF(COUNTR-4) 642,643,643                                               VIEWS
  643 COUNTR=0                                                               VIEWS
      KOUNTR=0                                                               VIEWS
      GO TO 641                                                              VIEWS
  640 CALL TESTN(F(J,K),DIV,KOUNTR,COUNTR)                                   VIEWS
      IF(KOUNTR)641,641,5000                                                 VIEWS
  641  IF(F(J,K) .LT.0.0) F(J,K) = 0.0                                       VIEWS
       IF(F(J,K) .LT.0.0) F(K,J) = 0.0                                       VIEWS
      NOD1=NODE(J)                                                           VIEWS
      NOD2=NODE(K)                                                           VIEWS
      FFSR(NOD1,NOD2)=F(J,K)                                                 VIEWS
      FFSR(NOD2,NOD1)=F(K,J)                                                 VIEWS
15000 CONTINUE                                                               VIEWS
      AREA(NOD1)= A(J)/144.0                                                 VIEWS
10000 CONTINUE                                                               VIEWS
15008 IF(PRINT6 .EQ. 0) GO TO 670                                            VIEWS
      WRITE(6,15001)                                                         VIEWS
15001 FORMAT(1H1,26X,28HSYSTEM INTERNAL VIEW FACTORS,//)                     VIEWS
      DO 16001 I=1,NTOT                                                      VIEWS
      DO 16000 J=I,NTOT                                                      VIEWS
      IF(LINET .GE. 58) GO TO 15002                                          VIEWS
15004 WRITE(6,650) I,J,FFSP(I,J),J,I,FFSR(J,I)                               VIEWS
650   FORMAT(18X,2HF(,I2,1H,,I2,3H)= ,F7.5,10X,2HF(,I2,1H,,I2,3H)= ,F7.5     VIEWS
     1)                                                                      VIEWS
      LINET=LINET+1                                                          VIEWS
      GO TO 16000                                                            VIEWS
15002 WRITE(6,15001)                                                         VIEWS
      LINET=4                                                                VIEWS
      GO TO 15004                                                            VIEWS
16000 CONTINUE                                                               VIEWS
```

```
      LINET=LINET+1
      ARE2=ARE1(I)*144.8                                      VIEWS$   743
      WRITE(6,15085) I,ARE2                                   VIEWS$   744
15085 FORMAT(28X,5HAREA(,I2,3H)= ,F7.2,8H SQ. IN.//)          VIEWS$   745
      LINET=LINET+2                                           VIEWS$   746
16001 CONTINUE                                                VIEWS$   747
  670 IF(KKKI.EQ.0) GO TO 671                                 VIEWS$   748
      DO 672 I=1,NTOT                                         VIEWS$   749
      PUNCH 673, (FFSR(I,IX),IX=I,NTOT)                       VIEWS$   750
      ARE2=ARE1(I)*144.                                       VIEWS$   751
  672 PUNCH 673, ARE2                                         VIEWS$   752
  673 FORMAT(8F10.5)                                          VIEWS$   753
      IF(ISTOPIT.EQ.3) STOP                                   VIEWS$   754
  671 CONTINUE                                                VIEWS$   755
      END                                                     VIEWS$   756
                                                              VIEWS$   757
```

```
      SUBROUTINE ARCCOS(CS,ANG,ITA)                                     ARCCOS   2
      PIE1 = 3.141592653589793                                          ARCCOS   3
      T=ABS(CS) - 1.0                                                   ARCCOS   4
      IF(T) 67,6601,6602                                                ARCCOS   5
 6601 IF(CS) 6603,6603,6604                                             ARCCOS   6
 6603 ANG = PIE1                                                        ARCCOS   7
      GO TO 70                                                          ARCCOS   8
 6604 ANG=0.0                                                           ARCCOS   9
      GO TO 70                                                          ARCCOS  10
 6602 IF(ABS(T)-1.0E-5) 6601,6601,6605                                  ARCCOS  11
C     NO SOLUTION                                                       ARCCOS  12
      ITA=2                                                             ARCCOS  13
      RETURN                                                            ARCCOS  14
   67 IF(CS) 6720,6710,6720                                             ARCCOS  15
 6710 ANG = PIE1/2.                                                     ARCCOS  16
      GO TO 70                                                          ARCCOS  17
 6720 TP2P1=SQRT(1.-CS**2)/CS                                           ARCCOS  18
      ANG=ATAN(TP2P1)                                                   ARCCOS  19
      IF(TP2P1) 60,70,70                                                ARCCOS  20
   60 ANG = ANG+ PIE1                                                   ARCCOS  21
C     A SOLUTION WAS FOUND                                              ARCCOS  22
   70 ITA=1                                                             ARCCOS  23
      RETURN                                                            ARCCOS  24
      END                                                               ARCCOS  25
```

```
      SUBROUTINE QUAD(A,B,C,RR1,RI1,RR2,RI2,IOR)                        QUAD   2
      IF(ABS(A)-1.0E-4)  5,5,30                                         QUAD   3
    5 IF(ABS(B)-1.0E-4)  10,10,15                                       QUAD   4
C      NO SOLUTION                                                      QUAD   5
   10    IOR=4                                                          QUAD   6
         RETURN                                                         QUAD   7
C        ONE REAL SOLUTION                                              QUAD   8
   15    RR1=-C/B                                                       QUAD   9
         IOR=2                                                          QUAD  10
         RETURN                                                         QUAD  11
   30    DISC = B*B-4.*A*C                                              QUAD  12
         IF(DISC) 40,50,60                                              QUAD  13
C        COMPLEX ROOTS                                                  QUAD  14
   40    IOR=3                                                          QUAD  15
         RR1 = - B/(2.*A)                                               QUAD  16
      RI1 = 0.5*SQRT(-DISC)/A                                           QUAD  17
         RR2= RR1                                                       QUAD  18
         RI2= - RI1                                                     QUAD  19
         RETURN                                                         QUAD  20
C      IDENTICAL ROOTS                                                  QUAD  21
   50    IOR =2                                                         QUAD  22
         RR1 = - B/(2.0*A)                                              QUAD  23
         RETURN                                                         QUAD  24
C        TWO REAL ROOTS                                                 QUAD  25
   60    IOR = 1                                                        QUAD  26
      RR1 = 0.5*(-B+SQRT(DISC))/A                                       QUAD  27
      RR2 = 0.5*(-B-SQRT(DISC))/A                                       QUAD  28
         RETURN                                                         QUAD  29
         END                                                            QUAD  30
```

```
      SUBROUTINE CUBIC(AA,BB,CC,DD,RR1,RR2,RR3,IC3)                    CUBIC
      PIE = 3.141592653589793                                          CUBIC
     SQ3=SQRT(3.0)                                                     CUBIC
     IF(ABS(AA)-1.0E-04) 5,5,10                                        CUBIC
    5 CALL QUAD(BB,CC,DD,RRR1,RRI1,RRR2,RRI2,IDR3)                     CUBIC
      IF(IDR3-2) 30,20,15                                              CUBIC
C     NO REAL SOLUTIONS                                                CUBIC
   15 IC3 = 4                                                          CUBIC
      RETURN                                                           CUBIC
C     ONE REAL SOLUTION                                                CUBIC
   20 IC3 = 3                                                          CUBIC
      RR1= RRR1                                                        CUBIC
      RETURN                                                           CUBIC
C     TWO REAL SOLUTIONS                                               CUBIC
   30 RR1= RRR1                                                        CUBIC
      RR2 = RRR2                                                       CUBIC
      IC3 = 2                                                          CUBIC
      RETURN                                                           CUBIC
   10 BL = BB/AA                                                       CUBIC
      CL = CC/AA                                                       CUBIC
      DL= DD/AA                                                        CUBIC
      P= CL-BL**2/3.                                                   CUBIC
      Q= DL-BL*CL/3.+2.*BL**3/27.                                      CUBIC
      DISC = Q**2/4. +P**3/27.                                         CUBIC
      IF(DISC) 40,50,60                                                CUBIC
   50 UA = -.5*Q                                                       CUBIC
      IF(UA) 80,45,80                                                  CUBIC
C     NO SOLUTION                                                      CUBIC
   45 IC3=4                                                            CUBIC
      RETURN                                                           CUBIC
   40 UI3=SQRT(-DISC)                                                  CUBIC
      UR3 = -.5*Q                                                      CUBIC
      UM = (UI3**2+UR3**2)**(1./6.)                                    CUBIC
     IF(ABS(UR3)-1.0E-04) 100,100,110                                  CUBIC
  100 ANG = PIE/2.                                                     CUBIC
      GO TO 200                                                        CUBIC
  110 T=ABS(UI3/UR3)                                                   CUBIC
     RANG=ATAN(T)                                                      CUBIC
      IF(UR3) 140,140,160                                              CUBIC
  140 ANG = PIE-RANG                                                   CUBIC
      GO TO 200                                                        CUBIC
  160 ANG = RANG                                                       CUBIC
  200 ZETAR=UM*COS(ANG/3.)                                             CUBIC
     ZETAI= UM*SIN(ANG/3.)                                             CUBIC
C     THREE REAL SOLUTIONS                                             CUBIC
      IC3=1                                                            CUBIC
      ETA1 = 2.*ZETAR                                                  CUBIC
      ETA2 = -ZETAR -SQ3*ZETAI                                         CUBIC
      ETA3 = -ZETAR + SQ3*ZETAI                                        CUBIC
      RR1= ETA1-BL/3.                                                  CUBIC
      RR2= ETA2-BL/3.                                                  CUBIC
      RR3= ETA3-BL/3.                                                  CUBIC
      RETURN                                                           CUBIC
   60 UA=-.5*Q + SQRT(DISC)                                            CUBIC
   80 IF(UA) 220,230,240                                               CUBIC
  230 UA=-.5*Q-SQRT(DISC)                                              CUBIC
      IF(UA) 220,225,240                                               CUBIC
```

```
C          ONE SOLUTION                                          CUBIC    59
      225  IC3= 3                                                CUBIC    60
           RR1=0.                                                CUBIC    61
           RETURN                                                CUBIC    62
      220  ZET1R = 0.5*(-UA)**(1./3.)                            CUBIC    63
           ZET1I =.5*SQ3*(-UA)**(1./3.)                          CUBIC    64
           GO TO 245                                             CUBIC    65
      240  ZET1R= (UA)**(1./3.)                                  CUBIC    66
           ZET1I = 0.0                                           CUBIC    67
      245  ZET2R = -.5*ZET1R -.5*SQ3*ZET1I                       CUBIC    68
           ZET2I = -.5*ZET1I + .5*SQ3*ZET1R                      CUBIC    69
           ZET3R = -.5*ZET1R +.5*SQ3*ZET1I                       CUBIC    70
           ZET3I= -.5*ZET1I-.5*SQ3*ZET1R                         CUBIC    71
           ZET4R = -P*ZET1R/(3.*(ZET1R**2+ZET1I**2))             CUBIC    72
           ZET4I= P*ZET1I/(3.*(ZET1R**2+ZET1I**2))               CUBIC    73
           ZET5R = -P*ZET3R/(3.*(ZET3R**2+ZET3I**2))             CUBIC    74
           ZET5I = P*ZET3I/(3.*(ZET3R**2+ZET3I**2))              CUBIC    75
           ZET6R = -P*ZET2R/(3.*(ZET2R**2+ZET2I**2))             CUBIC    76
           ZET6I = P*ZET2I/(3.*(ZET2R**2+ZET2I**2))              CUBIC    77
      200  K=0                                                   CUBIC    78
           ETA1R= ZET1R +ZET4R                                   CUBIC    79
           ETA1I= ZET1I+ZET4I                                    CUBIC    80
           ETA2R = ZET2R + ZET6R                                 CUBIC    81
           ETA2I = ZET2I+ZET6I                                   CUBIC    82
           ETA3R = ZET3R + ZET5R                                 CUBIC    83
           ETA3I = ZET3I + ZET5I                                 CUBIC    84
          IF(ABS(ETA1I)-1.0E-04) 290,290,300                     CUBIC    85
      290  RR1 = ETA1R-BL/3.                                     CUBIC    86
           K=1                                                   CUBIC    87
           IND=1                                                 CUBIC    88
      300 IF(ABS(ETA2I)-1.0E-04) 310,310,320                     CUBIC    89
      310  RR2= ETA2R -BL/3.                                     CUBIC    90
           K=K+1                                                 CUBIC    91
           IND=2                                                 CUBIC    92
      320 IF(ABS(ETA3I)-1.0E-04) 330,330,340                     CUBIC    93
      330  RR3= ETA3R-BL/3.                                      CUBIC    94
           K=K +1                                                CUBIC    95
           IND = 3                                               CUBIC    96
      340  IF(K-2)  350,350,360                                  CUBIC    97
C          ONE REAL SOLUTION                                     CUBIC    98
      350  GO TO(370,380,390),IND                                CUBIC    99
      380  RR1=RR2                                               CUBIC   100
           GO TO 370                                             CUBIC   101
      390  RR1=RR3                                               CUBIC   102
      370  IC3=3                                                 CUBIC   103
           RETURN                                                CUBIC   104
C          THREE REAL SOLUTIONS                                  CUBIC   105
      360  IC3=1                                                 CUBIC   106
           RETURN                                                CUBIC   107
           END                                                   CUBIC   108
```

```
      SUBROUTINE TEST1(R1T,R2T,PHIOT,PHI1T,X1T,Z1T,ITES1)
      DENO= R2T**2+R1T**2-2.*R2T*R1T*COS(PHIOT)
         IF(DENO) 20,20,10
   10    PHI2= PHI1T+PHIOT
      XF=R1T*R2T*SIN(PHIOT)*(R2T*SIN(PHI2)-R1T*SIN(PHI1T))/DENO
      ZF=-R1T*R2T*SIN(PHIOT)*(R2T*COS(PHI2)-R1T*COS(PHI1T))/DENO
      X2T=R2T*COS(PHI2)
      Z2T=R2T*SIN(PHI2)
      D1F= SQRT((X1T-XF)**2+(Z1T-ZF)**2)
      D2F= SQRT((X2T-XF)**2+(Z2T-ZF)**2)
      D12= SQRT((X2T-X1T)**2+(Z2T-Z1T)**2)
      IF(ABS(D1F-D12) -1.0E-03) 11,11,12
   11 D1F=D12
   12 IF(ABS(D2F-D12)-1.0E-03) 13,13,14
   13    D2F= D12
   14    IF(D1F-D12) 15,15,20
   15    IF(D2F-D12) 25,25,20
C        SOLUTION IS NOT VALID FOR THIS PROBLEM
   20    ITES1 = 2
         RETURN
C        SOLUTION IS VALID FOR THIS PROBLEM
   25    ITES1 = 1
         RETURN
         END
```

```
      SUBROUTINE TEST2(YU,YD,YF,IFYF)                                   TEST2    2
      YUYD=ABS(YD-YU)                                                   TEST2    3
      YFYD=ABS(YD-YF)                                                   TEST2    4
      YFYU=ABS(YU-YF)                                                   TEST2    5
      IF(ABS(YUYD-YFYD)-1.0E-03) 1,1,2                                  TEST2    6
    1 YFYD=YUYD                                                         TEST2    7
    2 IF(ABS(YUYD-YFYU)-1.0E-03) 3,3,4                                  TEST2    8
    3    YFYU= YUYD                                                     TEST2    9
    4    IF(YFYD-YUYD) 5,5,10                                           TEST2   10
    5    IF(YFYU-YUYD) 15,15,10                                         TEST2   11
C        YF IS NOT A VALID SOLUTION FOR THIS PROBLEM                    TEST2   12
   10    IFYF=2                                                         TEST2   13
         RETURN                                                         TEST2   14
C        YF IS A VALID SOLUTION FOR THIS PROBLEM                        TEST2   15
   15    IFYF = 1                                                       TEST2   16
         RETURN                                                         TEST2   17
         END                                                            TEST2   18
```

```
      SUBROUTINE FINDIT(Y,YF,I,NPS,NYU)                                 FINDIT   2
      DIMENSION YF(10,20)                                               FINDIT   3
      DO 100 J=1,NPS                                                    FINDIT   4
      IF(Y-YF(I,J)) 10,40,50                                            FINDIT   5
   10 IF(J-1) 20,20,30                                                  FINDIT   6
   20 NYU=0                                                             FINDIT   7
      GO TO 110                                                         FINDIT   8
   30 NYU=J-1                                                           FINDIT   9
      GO TO 110                                                         FINDIT  10
   40 NYU = J                                                           FINDIT  11
      GO TO 110                                                         FINDIT  12
   50 IF(J-NPS)100,60,60                                                FINDIT  13
   60 NYU=J                                                             FINDIT  14
      GO TO 110                                                         FINDIT  15
  100 CONTINUE                                                          FINDIT  16
  110  RETURN                                                           FINDIT  17
      END                                                               FINDIT  18
```

```
      SUBROUTINE CODE(NY1,NY2,NPS,ICODE)                              CODE   2
      IF(NY1) 10,10,15                                                CODE   3
   10 IF(NY2) 20,20,25                                                CODE   4
C     BOTH Y1 AND Y2 ARE UPSTREAM OF THE SHADOWING BODY               CODE   5
   20  ICODE=0                                                        CODE   6
      RETURN                                                          CODE   7
   25 IF(NY2-NPS) 30,35,35                                            CODE   8
C     Y1 IS UPSTREAM AND Y2 IS DOWNSTREAM OF THE SHADOWING BODY       CODE   9
   35 ICODE=1                                                         CODE  10
      RETURN                                                          CODE  11
C     Y1 IS UPSTREAM AND Y2 IS WITHIN Y BAND OF BODY                  CODE  12
   30   ICODE=2                                                       CODE  13
       RETURN                                                         CODE  14
   15 IF(NY1-NPS) 40,45,45                                            CODE  15
   40 IF(NY2) 50,50,55                                                CODE  16
C     Y1 IS WITHIN Y BAND OF BODY AND Y2 IS UPSTREAM OF IT            CODE  17
   50 ICODE = 3                                                       CODE  18
      RETURN                                                          CODE  19
   55  IF(NY2-NPS) 60,65,65                                           CODE  20
C Y1 IS WITHIN Y BAND OF BODY AND Y2 IS DOWNSTREAM OF IT              CODE  21
   65 ICODE = 4                                                       CODE  22
      RETURN                                                          CODE  23
C     Y1 IS WITHIN Y BAND OF BODY AND Y2 IS ALSO WITHIN THAT BAND     CODE  24
   60 ICODE = 5                                                       CODE  25
      RETURN                                                          CODE  26
   45 IF(NY2-NPS) 75,70,70                                            CODE  27
C    BOTH Y1 AND Y2 LIE DOWNSTREAM OF THE SHADOWING BODY              CODE  28
   70 ICODE =8                                                        CODE  29
      RETURN                                                          CODE  30
   75 IF(NY2) 80,80,85                                                CODE  31
C   Y1 IS DOWNSTREAM OF BODY AND Y2 IS WITHIN THE Y BAND OF THE BODY  CODE  32
   85 ICODE = 6                                                       CODE  33
      RETURN                                                          CODE  34
C  Y1 IS DOWNSTREAM OF BODY AND Y2 IS UPSTREAM OF IT                  CODE  35
   80 ICODE = 7                                                       CODE  36
      RETURN                                                          CODE  37
      END                                                             CODE  38
```

```
      SUBROUTINE CANSEE(Y1,R1,Y2,R2,YF,RF,KI,KIL,JJ,ISEE)
      DIMENSION  YF(10,20),RF(10,20)
      IO=0
       JO=0
      KICK =1
      KK= KI
       R2T= R2
   30 RUT=RF(JJ,KK)
      ROT= RF(JJ,KK+1)
      YUT = YF(JJ,KK)
      YOT = YF(JJ,KK+1)
      GO TO 60
   50 RUT= - RF(JJ,KK)
      ROT = - RF(JJ,KK+1)
      YUT = YF(JJ,KK)
       YOT = YF(JJ,KK+1)
   60 YDEN = ( R2T -R1)/(Y2-Y1) -(ROT-RUT)/(YOT-YUT)
       IF( ABS(YDEN) -1.0E-03) 200,200,70
   70 YNUM = ( RUT*YOT-ROT*YUT)/(YOT-YUT)-(R1*Y2-R2T*Y1)/(Y2-Y1)
      YI = YNUM /YDEN
     IF(ABS(Y1-YI)-1.0E-3) 200,200,80
   80 IF(ABS(Y2-YI)-1.0E-3) 200,200,90
   90  CALL TEST2( YUT,YOT,YI,LILY)
      IF(LILY-1) 55,65,200
   65 CALL TEST2(Y1,Y2,YI,LARFY)
      IF(LARFY-1) 67,67,200
   67 IF(KICK-2) 120,125,130
  120 KK=KI
      KICK =2
       IO=1
      R2T =- R2
      GO TO 30
  125 JO= 1
      KICK =3
      KK=KI
      GO TO 50
  130 JO=JO+1
       GO TO 155
  200 IF(KK-KIL) 135,140,140
  135 KK=KK+1
      IF(KICK-2) 30,30,50
  140 IF(KICK-2) 145,150,155
  145 KICK = 2
      R2T= -R2
      KK= KI
      GO TO 30
  150 KICK= 3
      KK= KI
      GO TO 50
  155 IF(IO) 160,160,165
  160 IF(JO) 170,170,175
  170  KK=KI
  190 YUT=YF(JJ,KK)
      RUT=RF(JJ,KK)
      CALL TEST2(Y1,Y2,YUT,IFY)
      IF(IFY-1) 201,201,195
  195 KK=KK+1
```

```
      IF(KK-KIL) 190,190,220                                          CANSEE  59
C     THE BODY CAUSES NO SHADOWING                                    CANSEE  60
  220 ISEE=1                                                          CANSEE  61
      RETURN                                                          CANSEE  62
  201 RC=  (Y2-YUT)*R1/(Y2-Y1)                                        CANSEE  63
      RHO= R2*(YUT-Y1)/(Y2-Y1)                                        CANSEE  64
      X1= RC+RHO                                                      CANSEE  65
      X2= RC-RHO                                                      CANSEE  66
      IF( ABS(RUT-X1)-1.0E-03) 195,195,205                            CANSEE  67
  205 IF( ABS(X2+RUT) -1.0E-03) 195,195,210                           CANSEE  68
  210 IF(X1-RUT) 220,220,230                                          CANSEE  69
  230 IF(X2+RUT) 220,240,240                                          CANSEE  70
C THE FRUSTUM SHADOWS WITH ITS OUTSIDE SURFACE BUT SHADOWING DOES NOT E CANSEE  71
C FOR PHI2= 180 DEGREES AS IT DOES FOR ISEE=2                         CANSEE  72
  240 ISEE= 5                                                         CANSEE  73
      RETURN                                                          CANSEE  74
C   THE BODY CAUSES SHADOWING WITH ITS OUTSIDE SURFACE                CANSEE  75
  175 ISEE = 2                                                        CANSEE  76
      RETURN                                                          CANSEE  77
  165 IF(JQ) 180,180,185                                              CANSEE  78
C     THE BODY CAUSES SHADOWING WITH ITS INSIDE SURFACE               CANSEE  79
  180  ISEE=3                                                         CANSEE  80
      RETURN                                                          CANSEE  81
C     THE BODY CAUSES COMPLETE SHADOWING                              CANSEE  82
  185 ISEE= 4                                                         CANSEE  83
      RETURN                                                          CANSEE  84
      END                                                             CANSEE  85
```

```
      SUBROUTINE BODY(Y1,Y2,R1,R2,YFU,RFU,YFD,RFD,PHIO,PHI1,ION)
      EF= (RFU*YFD-RFD*YFU)/(YFD-YFU)
      FF= (RFD-RFU)/(YFD-YFU)
      RC1= EF+FF*Y1
      RC2= EF+FF*Y2
      IF(ABS(RC1-R1)-1.0E-3) 10,12,20
   10 IF(ABS(RC2-R2)-1.0E-3) 30,30,20
C BOTH POINTS 1AND 2 LIE ON THE SHADOWING BODY)SHADOWING TAKEN CARE OF E
   30 ION=1
      RETURN
   20 IF(R1-ABS(RC1)) 9830,22,22
   22 IF(R2-ABS(RC2)) 9830,24,24
   24 AF = -(RFD-RFU)/SQRT((YFD-YFU)**2+(RFD-RFU)**2)
      BF =  (YFD-YFU)/SQRT((YFD-YFU)**2+(RFD-RFU)**2)
 9840 C1= BF*(Y2*R1**2+Y1*R2**2)-AF*EF*(Y2-Y1)**2
      C2=BF*(Y1+Y2)*R2*R1
      C3= BF*(R2**2+R1**2)+AF*FF*(Y2-Y1)**2
      C4= 2.*R2*R1*BF
      C5= FF**2*(Y2-Y1)**2-(R2**2+R1**2)
      C6 = 2.*R2*R1
      C7=2.*Y1*(R2**2+R1**2)+2.*(Y2-Y1)*R1**2+2.*EF*FF*(Y2-Y1)**2
     C8= 2.*(Y2+Y1)*R2*R1
      C9=(EF**2-R1**2)*(Y2-Y1)**2-(Y1*R2)**2+(Y1*R1)**2-2.*Y1*Y2*
     1 R1**2
      C10 = 2.*R2*R1*Y1*Y2
      AAF= C2**2*C6-C4*C2*C8+C4**2*C10
      BBF= -2.*C1*C2*C6+C2**2*C5+C4*(C1*C8+C2*C7)+(C3*C2*C8)+C9*
     1 C4**2-2.*C3*C4*C10
      CCF= C1**2*C6-2.*C1*C2*C5-C1*C7*C4-C3*(C1*C8+C2*C7)-2.*C9*C3*C4
     1 +C3**2*C10
      DDF= C1**2*C5+C1*C7*C3+C3**2*C9
      CALL CUBIC(AAF,BBF,CCF,DDF,RR1,RR2,RR3,IC)
      GO TO(9841,9851,9861,9830),IC
 9841 CALL ARCCOS(RR3,PHIO,ITA1)
      IF(ITA1-1) 9842,9842,9851
 9842 DED=C3-C4*RR3
      IF(ABS(DED) .LE. 1.0E-5)   GO TO 9851
      YF=(C1-C2*RR3)/DED
      CALL TEST2(YFU,YFD,YF,IFY)
      IF(IFY -1) 9843,9843,9851
 9843 CALL TEST2(Y1,Y2,YF,LOU1)
      IF(LOU1-1) 500,500,9851
  500 CALL CHECK( PHIO,PHI1,Y1,R1,Y2,R2,YF,AF,BF,EF,FF,IGO)
      IF(IGO-1) 9850,9850,9851
 9851 CALL ARCCOS(RR2,PHIO,ITA1)
      IF(ITA1 -1) 9852,9852,9861
 9852 DED=C3-C4*RR2
      IF(ABS(DED) .LE. 1.0E-5)   GO TO 9861
      YF=(C1-C2*RR2)/DED
      CALL TEST2(YFU,YFD,YF,IFY)
      IF(IFY -1) 9853,9853,9861
 9853 CALL TEST2(Y1,Y2,YF,LOU1)
      IF(LOU1-1) 510,510,9861
  510 CALL CHECK(PHIO,PHI1,Y1,R1,Y2,R2,YF,AF,BF,EF,FF,IGO)
      IF(IGO-1) 9850,9850,9861
 9861 CALL ARCCOS(RR1,PHIO,ITA1)
      IF(ITA1 - 1) 9862, 9862, 9830
```

```
 9862  DED=C3-C4*RR1                                                BODY  59
       IF(ABS(DED) .LE. 1.0E-5)   GO TO 9830                        BODY  60
       YF=(C1-C2*RR1)/DED                                           BODY  61
          CALL TEST2(YFU,YFD,YF,IFY)                                BODY  62
          IF(IFY - 1) 9863, 9863, 9830                              BODY  63
 9863     CALL TEST2(Y1,Y2,YF,LOU1)                                 BODY  64
          IF(LOU1-1) 520,520,9830                                   BODY  65
  522     CALL CHECK(PHIO,PHI1,Y1,R1,Y2,R2,YF,AF,BF,EF,FF,IGO)      BODY  66
          IF(IGO-1) 9850,9850,9830                                  BODY  67
C  A VALID SOLUTION HAS BEEN FOUND.                                 BODY  68
 9850     ION=2                                                     BODY  69
          RETURN                                                    BODY  70
C  NO VALID SOLUTION WAS FOUND.                                     BODY  71
 9830     ION=3                                                     BODY  72
          RETURN                                                    BODY  73
          END                                                       BODY  74
```

```
      SUBROUTINE CHECK(PHIO,PHI1,Y1,R1,Y2,R2,YF,AF,BF,EF,FF,IGO)        CHECK   2
     PHI2=PHI1+PHIO                                                     CHECK   3
     X1=R1*COS(PHI1)                                                    CHECK   4
     X2=R2*COS(PHI2)                                                    CHECK   5
     XF=X1+(YF-Y1)*(X2-X1)/(Y2-Y1)                                      CHECK   6
     Z1=R1*SIN(PHI1)                                                    CHECK   7
     Z2=R2*SIN(PHI2)                                                    CHECK   8
      ZF= Z1+(YF-Y1)*(Z2-Z1)/(Y2-Y1)                                    CHECK   9
      RF= EF+FF*YF                                                      CHECK  10
      RCFS = XF**2+ ZF**2                                               CHECK  11
      IF(RCFS) 10,10,20                                                 CHECK  12
C  NO BLOCKAGE INDICATED BY THIS SOLUTION                               CHECK  13
   10 IGO = 2                                                           CHECK  14
      RETURN                                                            CHECK  15
   20 RCF= SQRT(RCFS)                                                   CHECK  16
      IF(ABS(RCF-RF) -1.0E-03) 30,30,45                                 CHECK  17
C  THE SOLUTION IS AN EXTRANEOUS SOLUTION FOR THIS PROBLEM              CHECK  18
   45 IGO = 2                                                           CHECK  19
      RETURN                                                            CHECK  20
   30 CANG = (X2-X1)*BF*XF/RF+AF*(Y2-Y1)+(Z2-Z1)*BF*ZF/RF               CHECK  21
      IF(ABS(CANG)-1.0E-03) 60,60,50                                    CHECK  22
C  THE SOLUTION IS AN EXTRANEOUS SOLUTION FOR THIS PROBLEM              CHECK  23
   50 IGO = 2                                                           CHECK  24
      RETURN                                                            CHECK  25
C  THE SOLUTION IS THE CORRECT SOLUTION TO THE PROBLEM                  CHECK  26
   60 IGO= 1                                                            CHECK  27
      RETURN                                                            CHECK  28
      END                                                               CHECK  29
```

```
      SUBROUTINE RING(Y1,R1,Y2,R2,YF,RF,PHI,LOU)                        RING   2
      RC=(Y2-YF)*R1/(Y2-Y1)                                             RING   3
      RHO= R2*(YF-Y1)/(Y2-Y1)                                           RING   4
      IF(RF-(RC-RHO)) 10,10,20                                          RING   5
C THE CONE OF VISION DOES NOT INTERSECT THE SHADOWING FRUSTUM FOR THIS Y RING   6
C THIS APPLIES TO OUTSIDE SHADOWING ONLY.                               RING   7
   10 LOU=2                                                             RING   8
      RETURN                                                            RING   9
   20 XF= 0.5*(RC+RF*RF/RC-RHO*RHO/RC)                                  RING  10
       ZFS= RF**2-XF**2                                                 RING  11
      IF(ZFS)  30,40,40                                                 RING  12
C THE CONE OF VISION COMPLETELY SURROUNDS THE SHADOWING FRUSTUM FOR THI RING  13
C FOR OUTSIDE SHADOWING OR THE CONE OF VISION LIES INSIDE THE SHADOWING RING  14
C FRUSTUM FOR THIS YF FOR INSIDE SHADOWING                              RING  15
   30 LOU = 1                                                           RING  16
      RETURN                                                            RING  17
   40 X2R= R1+(Y2-Y1)*(XF-R1)/(YF-Y1)                                   RING  18
      CS= X2R/R2                                                        RING  19
      CALL ARCCOS(CS,PHI,IDA)                                           RING  20
      IF( IDA-1) 50,50,60                                               RING  21
C SOMETHING IS WRONG WITH THE SOLUTION OBTAINED FOR X2R.                RING  22
   60 LOU=3                                                             RING  23
       RETURN                                                           RING  24
C A SOLUTION FOR RING SHADOWING HAS BEEN FOUND .                        RING  25
   50 LOU= 4                                                            RING  26
      RETURN                                                            RING  27
      END                                                               RING  28
```

```
      SUBROUTINE PICMAX(PHIS,LARRY,LIM,PHAM)                            PICMAX   2
      DIMENSION  PHIS(20)                                               PICMAX   3
      IF(LIM-1) 1295,1890,1895                                          PICMAX   4
 1890 LARRY=LARRY+1                                                     PICMAX   5
      PHAM=PHIS(1)                                                      PICMAX   6
      GO TO 1295                                                        PICMAX   7
 1895 LAR Y = LAR  +1                                                   PICMAX   8
      PHAM=PHIS(                                                        PICMAX   9
      DO 1897 L   =2,LIM                                                PICMAX  10
      IF(PHAM-P    LIKE) ) 1898,1898,1897                               PICMAX  11
 1898 PHAM= PHIS(LIKE)                                                  PICMAX  12
 1897   CONTINUE                                                        PICMAX  13
 1295 RETURN                                                            PICMAX  14
      END                                                               PICMAX  15
```

```
      SUBROUTINE PICMIN(PHEO,LUKE,LUM,PHIM)
      DIMENSION  PHEO(20)                                               PICMIN   2
      IF(LUM -1) 1295,1620,1630                                         PICMIN   3
 1620 LUKE=LUKE+1                                                       PICMIN   4
      PHIM= PHEO(1)                                                     PICMIN   5
      GO TO 1295                                                        PICMIN   5
 1630 LUKE=LUKE+1                                                       PICMIN   7
      PHIM= PHEO(1)                                                     PICMIN   8
      DO 1640  LINK=2,LUM                                               PICMIN   9
      IF(PHIM-PHEO(LINK)) 1640,1650,1650                                PICMIN  10
 1650 PHIM=  PHEO(LINK)                                                 PICMIN  11
 1640 CONTINUE                                                          PICMIN  12
 1295 RETURN                                                            PICMIN  13
      END                                                               PICMIN  14
                                                                        PICMIN  15
```

```
      SUBROUTINE TESTN(FT,DIV,KOUNTR,COUNTR)                        TESTN     2
      DIMENSION DIV(2)                                              TESTN     3
      IF(KOUNTR)2,2,10                                              TESTN     4
    2 FT1=FT                                                        TESTN     5
    3 DO 5 I=1,2                                                    TESTN     6
    5 DIV(I)=DIV(I)+DIV(I)                                          TESTN     7
      KOUNTR=1                                                      TESTN     8
      COUNTR=COUNTR+1                                               TESTN     9
      RETURN                                                        TESTN    10
   10 IF(ABS(FT1-FT)-.001)15,4,4                                    TESTN    11
    4 FT1=FT                                                        TESTN    12
      GO TO 3                                                       TESTN    13
   15 KOUNTR=0                                                      TESTN    14
      COUNTR=0                                                      TESTN    15
      RETURN                                                        TESTN    16
      END                                                           TESTN    17
```

```
      OVERLAY(XRHP,13,0)                                                TAS18$   2
      PROGRAM TAS18                                                     TAS18$   3
      COMMON /TWX/ TF(80),N                                             TAS18$   4
      COMMON /PRINT/ PRINT1, PRINT2, PRINT3, PRINT4, PRINT5,            TAS18$   5
     *               PRINT6, PRINT7, PRINT8, PRINT9, PRINT0             TAS18$   6
      INTEGER PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8   TAS18$   7
     1,PRINT9,PRINT0                                                    TAS18$   8
      COMMON /TAIL/ NFILL1(122),EIR(80)                                 TAS18$   9
      COMMON /ALL/ NFILL2(135), A(80)                                   TAS18$  10
      COMMON F                                                          TAS18$  11
      DIMENSION F      (80,80)                                          TAS18$  12
      DIMENSION FA     (80,80)                                          TAS18$  13
      DIMENSION C      (80,80)                                          TAS18$  14
      DIMENSION AMAT   (80,80)                                          TAS18$  15
      DIMENSION BMAT   (80,80)                                          TAS18$  16
      DIMENSION SMAT   (80,80)                                          TAS18$  17
      EQUIVALENCE (F,FA)                                                TAS18$  18
      EQUIVALENCE (F,C)                                                 TAS18$  19
      EQUIVALENCE (F,AMAT)                                              TAS18$  20
      EQUIVALENCE (F,BMAT)                                              TAS18$  21
      EQUIVALENCE (F,SMAT)                                              TAS18$  22
      DIMENSION P      (80)                                             TAS18$  23
      DIMENSION QTOTAL(80)                                              TAS18$  24
      DIMENSION ALPHA  (80)                                             TAS18$  25
      DIMENSION T      (80)                                             TAS18$  26
      DIMENSION CT     (80)                                             TAS18$  27
      DIMENSION TSTART(80)                                              TAS18$  28
      DIMENSION S1     (240)                                            TAS18$  29
      DIMENSION S2     (80)                                             TAS18$  30
      DIMENSION BUFFER(240)                                             TAS18$  31
      EQUIVALENCE (BUFFER,S1)                                           TAS18$  32
C     NAMELIST/INPUT/ C                                                 TAS18$  33
      NDIM=80                                                           TAS18$  34
      BOLTZ=0.1714E-8                                                   TAS18$  35
      RELTOL=.00001                                                     TAS18$  36
      TNOTSP=65.                                                        TAS18$  37
      DO 101 I=1,NDIM                                                   TAS18$  38
      P(I)=0                                                            TAS18$  39
      CT(I)=TF(I)                                                       TAS18$  40
  101 TSTART(I)=-500.                                                   TAS18$  41
      NX2=N*2                                                           TAS18$  42
      NX3=N*3                                                           TAS18$  43
      CALL CEDIT (NDIM,N)                                               TAS18$  44
      CALL WRIT14      (C,N,NX2,NX3,1,BUFFER)                           TAS18$  45
      CALL       FEDIT (NDIM,N,  NFILL2(124))                           TAS18$  46
      CALL WRIT14      (F,N,NX2,NX3,2,BUFFER)                           TAS18$  47
      DO 120 I=1,N                                                      TAS18$  48
      IF (CT    (I).NE.-500.) GO TO 116                                 TAS18$  49
C     IF (NCASE.GT.1) GO TO 120                                         TAS18$  50
  112 IF (TSTART(I).NE.-500.) GO TO 114                                 TAS18$  51
      TF(I)=TNOTSP                                                      TAS18$  52
      GO TO 118                                                         TAS18$  53
  114 TF(I)=TSTART(I)                                                   TAS18$  54
      GO TO 118                                                         TAS18$  55
  116 TF(I)=CT(I)                                                       TAS18$  56
  118 T(I)=TF(I)+460.                                                   TAS18$  57
  120 CONTINUE                                                          TAS18$  58
```

```
      CALL       SCRPTF (NDIM,F,M,EIR,A,1,8,
     1     S1,S2,NX2,NX3,BUFFER)
      CALL WRIT14      (F,N,NX2,NX3,3,BUFFER)
      DO 539 INDEX=1,15
        REWIND 2
      IF (INDEX.EQ.1) GO TO 505
      CALL DINVRT (NDIM,SMAT  ,N,ALPHA,1,S1,S2)
      DO 538 I=1,N
      TF(I)=ALPHA(I)-460.
  538 T (I)=ALPHA(I)
  505 IEND=1
      DO 520 I=1,N
      DO 530 J=1,N
  530 SMAT(I,J)=C.
      DO 511 I=1,N
  511 ALPHA(I)=-(ABS(P(I)))
      DO 503 I=1,N
      IF (CT(I).LT.(-499.)) GO TO 503
      DO 502 J=1,N
  502 SMAT(I,J)=CRODEL(I,J)
      ALPHA(I)=CT(I)+460.
  503 CONTINUE
      DO 510 I=1,N
      READ ( 2)  (BUFFER(J),J=1,NX3)
      DO 504 J=1,N
      IF (CT(I).GT.(-499.)) GO TO 504
      IF (I.EQ.J) GO TO 504
      J3=J+NX2
      SMAT(I,I)=SMAT(I,I)-BUFFER(J)-BOLTZ*BUFFER(J3)*4.0*(T(I)**3)
      SMAT(I,J)=        BUFFER(J)+BOLTZ*BUFFER(J3)*4.0*(T(J)**3)
      ALPHA(I)=ALPHA(I)-BOLTZ*BUFFER(J3)*3.0*((T(I)**4)-(T(J)**4))
  504 CONTINUE
      QTOTAL(I)=-(ABS(P(I)))
      DO 506 J=1,N
      J3=J+NX2
      IF ((BUFFER(J)+BUFFER(J3)      ).EQ.(0.)) GO TO 506
      QC=BUFFER   (J)*((T(I)    )-(T(J)    ))
      QIR=BUFFER(J3)*((T(I)**4)-(T(J)**4))*BOLTZ
      QTOTAL(I)=QTOTAL(I)+QC+QIR
  506 CONTINUE
      IF (CT(I).GT.(-499.)) GO TO 510
      IF(ABS(QTOTAL(I)).GT.RELTOL)  IEND=0
  510 CONTINUE
      IF (IEND.EQ.1) GO TO 300
  539 CONTINUE
  300 DO 310 I=1,N
  310 TF(I)=TF(I)+460.0
 1013 FORMAT(1H1,25X,"SYSTEM NODE TEMPERATURES",//)
 1014 FORMAT(35X,"NODE NO. ",I2,/26X,"TEMPERATURE=",F7.2," DEG. R.",/)
      IF(PRINT7 .EQ. 0) GO TO 200
      WRITE(6,1013)
      LINECT=4
      DO 231 I=1,N
      IF((LINECT .LE. 56) GO TO 203
      WRITE(6,1013)
      LINECT=4
  231 WRITE(6,1014) I,TF(I)
```

```
115              LINECT=LINECT+3
            201  CONTINUE                                              TAS18$    116
            200  CONTINUE                                              TAS18$    117
                 END                                                   TAS18$    118
                                                                       TAS1?$    119
```

```
      FUNCTION CRODEL(I,J)                                              CRODEL     2
      IF (I.NE.J) GO TO 1                                               CRODEL     3
      CRODEL=1.                                                         CRODEL     4
      RETURN                                                            CRODEL     5
    1 CRODEL=0.                                                         CRODEL     6
      RETURN                                                            CRODEL     7
      END                                                               CRODEL     8
```

```
      SUBROUTINE MATPOS (NDIM,A,N)                                      MATPOS   2
      DIMENSION A(NDIM,NDIM)                                            MATPOS   3
      DO 1 I=1,N                                                        MATPOS   4
      DO 1 J=1,N                                                        MATPOS   5
      A(I,J)=ABS(A(I,J))                                                MATPOS   6
    1 CONTINUE                                                          MATPOS   7
      RETURN                                                            MATPOS   8
      END                                                               MATPOS   9
```

```
      SUBROUTINE MATSYM (NDIM,F,N)                                      MATSYM     2
      DIMENSION F(NDIM,NDIM)                                            MATSYM     3
      NM=N-1                                                            MATSYM     4
      DO 3 I=1,NM                                                       MATSYM     5
      IP=I+1                                                            MATSYM     6
      DO 3 J=IP,N                                                       MATSYM     7
      IF (F(I,J).EQ.(0.)) GO TO 2                                       MATSYM     8
    1 F(J,I)=F(I,J)                                                     MATSYM     9
      GO TO 3                                                           MATSYM    10
    2 IF (F(J,I).EQ.(0.)) GO TO 3                                       MATSYM    11
      F(I,J)=F(J,I)                                                     MATSYM    12
    3 CONTINUE                                                          MATSYM    13
      RETURN                                                            MATSYM    14
      END                                                               MATSYM    15
```

```
      SUBROUTINE DINVRT (NDIM,A,NIN    ,B,MIN    ,S1,S2)                DINVRT   2
      DIMENSION A(NDIM,NDIM),B(NDIM,2)                                  DINVRT   3
      DIMENSION S1(2),S2(2)                                             DINVRT   4
      INTEGER Z1,Z2,S1                                                  DINVRT   5
      EQUIVALENCE (IROW,JROW), (ICOLUM,JCOLUM), (AMAX, T, SWAP)         DINVRT   6
      N=NIN                                                             DINVRT   7
      M=MIN                                                             DINVRT   8
      DO 20 J=1,N                                                       DINVRT   9
   20 S1(J)=0                                                           DINVRT  10
      DO 550 I=1,N                                                      DINVRT  11
      Z1=I+N                                                            DINVRT  12
      Z2=Z1+N                                                           DINVRT  13
      AMAX=0.0                                                          DINVRT  14
      DO 105 J=1,N                                                      DINVRT  15
      IF (S1(J).EQ.1) GO TO 105                                         DINVRT  16
      DO 100 K=1,N                                                      DINVRT  17
      IF (S1(K)-1) 80,100,740                                           DINVRT  18
   80 IF(ABS(AMAX)-ABS(A(J,K))) 85,100,100                              DINVRT  19
   85 IROW=J                                                            DINVRT  20
      ICOLUM=K                                                          DINVRT  21
      AMAX=A(J,K)                                                       DINVRT  22
  100 CONTINUE                                                          DINVRT  23
  105 CONTINUE                                                          DINVRT  24
      S1(ICOLUM)=S1(ICOLUM)+1                                           DINVRT  25
      IF (IROW.EQ.ICOLUM) GO TO 260                                     DINVRT  26
      DO 200 L=1,N                                                      DINVRT  27
      SWAP=A(IROW,L)                                                    DINVRT  28
      A(IROW,L)=A(ICOLUM,L)                                             DINVRT  29
  200 A(ICOLUM,L)=SWAP                                                  DINVRT  30
      IF (M.LE.0) GO TO 260                                             DINVRT  31
      DO 250 L=1, M                                                     DINVRT  32
      SWAP=B(IROW,L)                                                    DINVRT  33
      B(IROW,L)=B(ICOLUM,L)                                             DINVRT  34
  250 B(ICOLUM,L)=SWAP                                                  DINVRT  35
  260 S1(Z1)=IROW                                                       DINVRT  36
      S1(Z2)=ICOLUM                                                     DINVRT  37
      S2(I)=A(ICOLUM,ICOLUM)                                            DINVRT  38
      A(ICOLUM,ICOLUM)=1.0                                              DINVRT  39
      DO 350 L=1,N                                                      DINVRT  40
  350 A(ICOLUM,L)=A(ICOLUM,L)/S2(I)                                     DINVRT  41
      IF (M.LE.0) GO TO 380                                             DINVRT  42
      DO 370 L=1,M                                                      DINVRT  43
  370 B(ICOLUM,L)=B(ICOLUM,L)/S2(I)                                     DINVRT  44
  380 DO 550 L1=1,N                                                     DINVRT  45
      IF (L1.EQ.ICOLUM) GO TO 550                                       DINVRT  46
      T=A(L1,ICOLUM)                                                    DINVRT  47
      A(L1,ICOLUM)=0.0                                                  DINVRT  48
      DO 450 L=1,N                                                      DINVRT  49
  450 A(L1,L)=A(L1,L)-A(ICOLUM,L)*T                                     DINVRT  50
      IF (M.LE.0) GO TO 550                                             DINVRT  51
      DO 500 L=1,M                                                      DINVRT  52
  500 B(L1,L)=B(L1,L)-B(ICOLUM,L)*T                                     DINVRT  53
  550 CONTINUE                                                          DINVRT  54
      DO 710 I=1,N                                                      DINVRT  55
      L=N+1-I                                                           DINVRT  56
      L1=L+N                                                            DINVRT  57
      L2=L1+N                                                           DINVRT  58
```

```
      IF (S1(L1).EQ.S1(L2)) GO TO 710                                   DINVRT   59
      JROW=S1(L1)                                                       DINVRT   60
      JCOLUM=S1(L2)                                                     DINVRT   61
      DO 705 K=1,N                                                      DINVRT   62
      SWAP=A(K,JROW)                                                    DINVRT   63
      A(K,JROW)=A(K,JCOLUM)                                             DINVRT   64
      A(K,JCOLUM)=SWAP                                                  DINVRT   65
  705 CONTINUE                                                          DINVRT   66
  710 CONTINUE                                                          DINVRT   67
  740 RETURN                                                            DINVRT   68
      END                                                               DINVRT   69
```

```
      SUBROUTINE WRIT14      (MATRIX,N,NX2,NX3,MATNO,BUFFER)          WRIT14    2
      REAL MATRIX(80,80),  BUFFER(240)                                WRIT14    3
      REWIND 2                                                        WRIT14    4
      REWIND 4                                                        WRIT14    5
      DO 7 I=1,N                                                      WRIT14    6
      GO TO (1,2,3) MATNO                                             WRIT14    7
    1 DO 4 J=1,N                                                      WRIT14    8
    4 BUFFER(J)=MATRIX(I,J)                                           WRIT14    9
      WRITE(2) (BUFFER(J),J=1,N)                                      WRIT14   10
      GO TO 7                                                         WRIT14   11
    2 READ(2) (BUFFER(J), J=1,N)                                      WRIT14   12
      DO 5 J=1,N                                                      WRIT14   13
      J2=J+N                                                          WRIT14   14
    5 BUFFER(J2)=MATRIX(I,J)                                          WRIT14   15
      WRITE(4) (BUFFER(J),J=1,NX2)                                    WRIT14   16
      GO TO 7                                                         WRIT14   17
    3 READ(4) (BUFFER(J), J=1,NX2)                                    WRIT14   18
      DO 6 J=1,N                                                      WRIT14   19
      J3=J+NX2                                                        WRIT14   20
    6 BUFFER(J3)=MATRIX(I,J)                                          WRIT14   21
      WRITE(2) (BUFFER(J),J=1,NX3)                                    WRIT14   22
    7 CONTINUE                                                        WRIT14   23
      RETURN                                                          WRIT14   24
      END                                                             WRIT14   25
```

```
      SUBROUTINE FEDIT (NDIM,N,N1)                                    FEDIT   2
      COMMON /ALL/ NFILL2(135), A(80)                                 FEDIT   3
      COMMON/PLM/Q3(5000)                                             FEDIT   4
      COMMON FA                                                       FEDIT   5
      DIMENSION F      (50,50)                                        FEDIT   6
      DIMENSION FA     (80,80)                                        FEDIT   7
      EQUIVALENCE (Q3(1501),F(1,1))                                   FEDIT   8
      DO 5 I=1,N                                                      FEDIT   9
      DO 5 J=1,N                                                      FEDIT  10
    5 FA(I,J)=0.                                                      FEDIT  11
      DO 4 I=1,N1                                                     FEDIT  12
      DO 4 J=I,N1                                                     FEDIT  13
    4 FA(I,J)=F(I,J)                                                  FEDIT  14
      DO 6 I=1,N                                                      FEDIT  15
      DO 6 J=1,N                                                      FEDIT  16
    6 FA(I,J)=A(I)*FA(I,J)                                            FEDIT  17
    7 CALL MATPOS (NDIM,FA,N)                                         FEDIT  18
      CALL MATSYM (NDIM,FA,N)                                         FEDIT  19
      DO 9 I=1,N                                                      FEDIT  20
      IF (A(I).EQ.0.) GO TO 9                                         FEDIT  21
      DO 8 J=1,N                                                      FEDIT  22
    8 FA(I,J)= FA(I,J)/A(I)                                           FEDIT  23
    9 CONTINUE                                                        FEDIT  24
      RETURN                                                          FEDIT  25
      END                                                             FEDIT  26
```

```
      SUBROUTINE CEDIT (NDIM,N)                                         CEDIT       2
      COMMON C                                                          CEDIT       3
      DIMENSION C(80,92)                                                CEDIT       4
      COMMON /HTPACK/ IHT(80),HT1(80), IH                               CEDIT       5
      DO 4 I=1,N                                                        CEDIT       6
      DO 4 J=1,N                                                        CEDIT       7
    4 C(I,J)=0.                                                         CEDIT       8
      DO 100 I=1,IH                                                     CEDIT       9
      I9=IHT(I)/100                                                     CEDIT      10
      I8=IHT(I)-I9*100                                                  CEDIT      11
  100 C(I9,I8)=HT1(I)                                                   CEDIT      12
      CALL MATPOS (NDIM,C ,N)                                           CEDIT      13
      CALL MATSYM (NDIM,C ,N)                                           CEDIT      14
      RETURN                                                            CEDIT      15
      END                                                               CEDIT      16
```

```
      SUBROUTINE SCRPTF (NDIM,F,N,E,A,BOLTZ,        S1,S2,NX2,NX3,BUFFER) SCRPTF   2
      DIMENSION F(80,80)                                                  SCRPTF   3
      DIMENSION E      (80)                                               SCRPTF   4
      DIMENSION A      (80)                                               SCRPTF   5
      DIMENSION S1     (240)                                              SCRPTF   6
      DIMENSION S2     (80)                                               SCRPTF   7
      DIMENSION BUFFER(240)                                               SCRPTF   8
      DO 1 I=1,N                                                          SCRPTF   9
      DO 1 J=1,N                                                          SCRPTF  10
    1 F(I,J)=CRODEL(I,J)-((1.-E(I))*F(I,J))                               SCRPTF  11
    3 CALL DINVPT (NDIM,F,N,E,B,S1,S2)                                    SCRPTF  12
       REWIND 2                                                           SCRPTF  13
      REWIND 4                                                            SCRPTF  14
    5 DO 8 I=1,N                                                          SCRPTF  15
      READ(4) (BUFFER(J),J=1,NX2)                                         SCRPTF  16
      DO 7 J=1,N                                                          SCRPTF  17
      S2(J)=0.                                                            SCRPTF  18
      DO 7 K=1,N                                                          SCRPTF  19
      K2=K+N                                                              SCRPTF  20
      S2(J)=S2(J)+BUFFER(K2)*F(K,J)                                       SCRPTF  21
    7 CONTINUE                                                            SCRPTF  22
      WRITE(2) (S2(J),J=1,N)                                              SCRPTF  23
    8 CONTINUE                                                            SCRPTF  24
      REWIND 2                                                            SCRPTF  25
      DO 100 I=1,N                                                        SCRPTF  26
       READ(2) (S2(J),J=1,N)                                              SCRPTF  27
      DO 100 J=1,N                                                        SCRPTF  28
      F(I,J)-S2(J)                                                        SCRPTF  29
  100 CONTINUE                                                            SCRPTF  30
   10 DO 11 I=1,N                                                         SCRPTF  31
      PART=E(I)*A(I)*BOLTZ                                                SCRPTF  32
      DO 11 J=1,N                                                         SCRPTF  33
   11 F(I,J)=F(I,J)*E(J)*PART                                             SCRPTF  34
      RETURN                                                              SCRPTF  35
      END                                                                 SCRPTF  36
```

```
      OVERLAY(XRHP,14,0)                                             TAILS  2
      PROGRAM TAIL                                                   TAILS  3
      COMMON/T/ THA(20),K5C,NAS,NNL,NPLOT                            TAILS  4
      CALL OVERLAY(6HXRHP,12,1)                                      TAILS  5
C     CALL TAIL1                                                     TAILS  6
      CALL OVEPLAY(6HXRHP,12,2)                                      TAILS  7
C     CALL TAIL2                                                     TAILS  8
      END                                                            TAILS  9
```

```
      SUBROUTINE PLOT1(ANGLE,A,N,M,NL,III)
      DIMENSION OUT(131),YPR(11),ANG(6),A(1),BLANK(1)
      COMMON/FF/ R,HT,HS
      DATA BLANK,ANG/1H ,4H1111,4H2222,4H3333,4H4444,4H5555,4H6666/
      K=(N/NL)+1
      NLL=NL
      IF(NLL)20,10,20
   10 NLL=55
   20 IF(III .EQ. 0) GO TO 91
      WRITE(6,4) ANGLE,HT,HS,R
      GO TO 92
   91 WRITE(6,1) ANGLE
   92 YSCAL = (A(N)-A(1))/(FLOAT(NLL-1)) + 0.5E-10
      M1=N+1
      YMIN=A(M1)
      YMAX=YMIN
      M2=M*N
      DO 40 J=M1,M2
      IF(A(J)-YMIN) 28,26,26
   26 IF(A(J)-YMAX) 40,40,30
   28 YMI   (J)
      GO    40
   30 YMAX=A(J)
   40 CONTINUE
      YSCAL=(YMAX-YMIN)/100.0
      XB=A(1)
      L=1
      MY=M-1
      I=1
   45 F=I-1
      XPR=XB+F*XSCAL
      IF(A(L)-XPR) 50,50,70
   50 DO 55 IX=1,101
   55 OUT(IX)=BLANK(1)
      DO 60 J=1,MY
      LL=L+J*N
      JP=((A(LL)-YMIN)/YSCAL)+1.0
      OUT(JP)=ANG(J)
   60 CONTINUE
      WRITE(6,2) XPR,(OUT(IZ),IZ=1,101)
      L=L+K
      GO TO 80
   70 WRITE(6,7) XPR
   80 I=I+1
      IF(I-NLL) 45,84,86
   84 XPR=A(N)
      GO TO 50
   86 WRITE(6,7)
      YPR(1)=YMIN
      DO 90 KN=1,9
   90 YPR(KN+1)=YPR(KN)+YSCAL*10.0
      YPR(11)=YMAX
      WRITE(6,8)(YPR(IP),IP=1,11)
    1 FORMAT(1H1,/////////,37X,"RADIANT INTENSITY, NO ATMOSPHERIC ATTENU
     1ATION",/,46X,"OFF-AXIS ANGLE= ",F4.1," DEG.",//,5X,"(MICRONS)")
    2 FORMAT(F11.2,"    I",101A1)
    4 FORMAT(1H1,/////,36X,"RADIANT INTENSITY, ATMOSPHERIC ATTENUATED",/
```

```
                    1,46X,"OFF-AXIS ANGLE=",                                                   PLOT1   59
  60                2       F4.1," DEG.",/,47X,"TARGET ALTITUDE=",F7.1," FT.",/,47X,           PLOT1   60
                    3"SENSOP ALTITUDE=",F7.1," FT.",/,43X,"TARGET TO SENSOR RANGE=",           PLOT1   61
                    4F7.1," FT.",//,5X,"(MICRONS)")                                            PLOT1   62
              7      FORMAT(15X,1HI,16(10H---------I))                                         PLOT1   63
              3      FORMAT(12X,11(F7.3,3X1,/,55X,"RADIANT INTENSITY",/,55X,"(WATTS/STE        PLOT1   64
                    1RADIAN)")                                                                 PLOT1   65
  63        388      RETURN                                                                    PLOT1   66
                     END                                                                       PLOT1   67
```

```
      OVERLAY(XRHP,14,1)                                                TAIL1     2
      PROGRAM TAIL1                                                     TAIL1     3
      COMMON/PLM/QB(5000)                                               TAIL1     4
      COMMON/ALL/ N,NN,NNN,ISURF(50),NODE(55),JSURF(5,2),XF(5),NTOT1,   TAIL1     5
     *                  NOP,NP(10), AREA(80)                             TAIL1     6
      COMMON /TAIL/ NF,YFA(30),YFB(30),RFA(30),RFB(30),TPL,EMM(50)      TAIL1     7
      COMMON /TWY/ TH(80)                                               TAIL1     8
      COMMON /PRINT/ PRINT1, PRINT2, PRINT3, PRINT4, PRINT5,            TAIL1     9
     *                 PRINT6, PRINT7, PRINT8, PRINT9, PRINT0           TAIL1    10
      DIMENSION   FE(30,50),           F(50,50), X1(55),  Y1(55), X2(55), TAIL1    11
     *       Y2(55), VECT(55), YF(10,20), RF(10,20)                     TAIL1    12
      INTEGER PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8   TAIL1    13
     1,PRINT9,PRINT0                                                    TAIL1    14
      EQUIVALENCE (QB(1),FE(1)),(QB(1501),F(1)),(QB(4001),X1(1)),       TAIL1    15
     1(QB(4056),Y1(1)),(QB(4111),X2(1)),(QB(4166),Y2(1)),(QB(4221),     TAIL1    15
     2VECT(1)),                      (QB(4281),YF(1)),(QB(4681),RF(1))  TAIL1    17
      COMMON/T/ THA(20),K50,NAS,NWL,NPLOT                               TAIL1    18
    1 FORMAT(2X,2I2,F10.3)                                              TAIL1    19
    5 FORMAT(8F10.5)                                                    TAIL1    20
      CALL SHADOW(NNN,NP,YF,RF,NF,YFA,YFB,RFA,RFB)                      TAIL1    21
      READ(5,1) NAS                                                     TAIL1
      READ(5,5)(THA(I),I=1,NAS)                                         TAIL1    23
      CALL RECII(X1,Y1,X2,Y2,VECT,NTOT1,NF,RFA,RFB,YFA,YFB,NODE,TPL,    TAIL1    24
     1NAS,NNN,THA,FE)                                                   TAIL1    25
      READ(5,1) K50,NPLOT,WL                                            TAIL1    26
      IF(WL.LT.1.0)  WL=14.                                             TAIL1    27
      NWL=(WL-1.0)/0.02+1.0005                                          TAIL1    28
      IF(K50 .NE. 0) GO TO 300                                          TAIL1    29
      PRINT9=1                                                          TAIL1    30
  300 CONTINUE                                                          TAIL1    31
      END                                                               TAIL1    32
```

```
      SUBROUTINE SHADOW(NNN,NP,YF,RF,NF,YFA,YFB,RFA,RFB)
      DIMENSION NP(1),YF(10,20),RF(10,20),YFA(1),YFB(1),RFA(1),RFB(1)
    1 NF=0
      DO 20 I=1,NNN
      KK=1
      K=2
      NPP=NP(I)-1
    7 IF(K .GT. NPP) GO TO 25
      GO TO 5
   25 J=K
      GO TO 12
    5 CH1=RF(I,K)-RF(I,KK)
      IF(CH1 .EQ. 0.0) GO TO 15
      TH1=(YF(I,K)-YF(I,KK))/CH1
      GO TO 16
   15 TH1=0.0
   16 DO 11 J=K,NPP
      CH2=RF(I,J+1)-RF(I,J)
      IF(CH2 .EQ. 0.0) GO TO 17
      TH2= (YF(I,J+1)-YF(I,J))/CH2
      GO TO 18
   17 TH2=0.0
   18 TH=ABS(TH1-TH2)
      IF(TH .LE. 0.0001) GO TO 11
    3 NF=NF+1
      YFA(NF)=YF(I,KK)
      YFB(NF)=YF(I,J)
      RFA(NF)=RF(I,KK)
      RFB(NF)=RF(I,J)
      KK=J
      K=J+1
      IF(J .EQ. NPP) GO TO 12
      GO TO 7
   11 CONTINUE
   12 J=NPP+1
      NF=NF+1
      YFA(NF)=YF(I,KK)
      YFB(NF)=YF(I,J)
      RFA(NF)=RF(I,KK)
      RFB(NF)=RF(I,J)
   20 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE REDII(X11,Y11,X22,Y22,VECT,NSEC,NF,RFA,RFB,YFA,YFB,
     1NODE,TPL,NAS,NNN,THA,FE)
      DIMENSION X11(1),Y11(1),X22(1),Y22(1),VECT(1),NODE(1) ,FE(30,50)
     *         , HDIV(50),RS1(50),RS2(50),RFA(1),RFB(1),TH(50),THA(1),
     * THET(10),YS1(50),YS2(50),YFA(2),YFB(1),YF(2),YDUCT(4),RDUCT(4)
      COMMON/AAA/ YDUCT,RDUCT,IDUCT
      COMMON /PRINT/ PRINT1, PRINT2, PRINT3, PRINT4, PRINT5,
     *               PRINT6, PRINT7, PRINT8, PRINT9, PRINT0
      INTEGER PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8
     1,PRINT9,PRINT0
       PIE = 3.141592653589793
      RE=6.0E3
      NAL=NSEC
      NAF=1
      DNP=18.
      NDIV = 18
       DPHI = PIE / DNP
      DO 11 I=NAF,NSEC
      YS1(I)=X11(I)
      YS2(I)=X22(I)
      RS1(I)=Y11(I)
      RS2(I)=Y22(I)
      IV=X22(I)-X11(I)
      IF(IV .NE. 0) GO TO 18
      IV=ABS(Y22(I)-Y11(I))
   18 HDIV(I)=MAX0(IV,1)
      CALL VECANG(X11,Y11,X22,Y22,VECT,TH,NSEC)
      IF(IDUCT .EQ. 0) GO TO 31
      YCOR1=YDUCT(1)
      YCOR2=YDUCT(2)
      YCOR3=YDUCT(3)
      YCOR4=YDUCT(4)
      RCOR1=RDUCT(1)
      RCOR2=RDUCT(2)
      RCOR3=RDUCT(3)
      RCOR4=RDUCT(4)
       DUCTS = IDUCT
      DTHET=2.0*PIE/DUCTS
      THET(1)=0.0
       IDUC = IDUCT - 1
       DO 60 IMP= 1,IDUC
   60  THET( IMP + 1) = THET( IMP) + DTHET
   31 IF(PRINT8 .NE. 0) CALL RITE(LINEF)
10001 FORMAT(/,24X,"OFF-AXIS ANGLE=",F6.2," DEG,")
10002 FORMAT(28X,"F(DETECTOR,",I2,")=",E12.5)
   33 DO 33 N=1,NAS
      LLL=0
      IF(PRINT8 .EQ. 0) GO TO 20000
      IF(LINEF .GE. 58) CALL RITE(LINEF)
      WRITE(6,10001) THA(N)
      LINEF=LINEF+1
20000 THAI=PIE*THA(N)/180.0
      ST = SIN(THAI)
      CT = COS(THAI)
      XA=RE*ST
       YA = TPL + RE * CT
      ZA=0.0
```

```
      XAN=-ST                                                           REDII
      YAN=-CT                                                           REDII
      ZAN=3.0                                                           REDII
       DO 7 I= NAF,NAL                                                  REDII
       IF (IDUCT) 612,612, 610                                          REDII
  610   IF (YS1(I) -YCOR2 ) 2000,612,612                                REDII
 2000    SHAD = 1.0                                                     REDII
       GO TO 628                                                        REDII
  612    SHAD=0.0                                                       REDII
  628 TAU=TH(I)*PIE/180.0                                               REDII
      CT=COS(TAU)                                                       REDII
      ST=SIN(TAU)                                                       REDII
      DRB=(RS2(I)-RS1(I))/HDIV(I)                                       REDII
      DYB=(YS2(I)-YS1(I))/HDIV(I)                                       REDII
      YB=YS1(I)-.5*DYB                                                  REDII
      NHB=HDIV(I)                                                       REDII
      FAB=0.0                                                           REDII
      DHB=SQRT(DRB**2 + DYB**2)                                         REDII
      RSB=RS1(I) - 0.5*DRB                                              REDII
       YBN =  - ST                                                      REDII
       DO 25  ISB= 1,NHB                                                REDII
      YB=YB+DYB                                                         REDII
      RSB=RSB+DRB                                                       REDII
      DA=DPHI*RSB*DHB                                                   REDII
      PHI=-.5*DPHI                                                      REDII
       DO 5 J = 1,NDIV                                                  REDII
      PHI=PHI+DPHI                                                      REDII
       SP= SIN(PHI)                                                     REDII
       CP= COS(PHI)                                                     REDII
      XB=RSB*CP                                                         REDII
      ZB=RSB*SP                                                         REDII
      XBN=CT*CP                                                         REDII
      ZBN=CT*SP                                                         REDII
      DX=XB-XA                                                          REDII
      DY=YB-YA                                                          REDII
      DZ=ZB-ZA                                                          REDII
      R2=DX*DX+DY*DY+DZ*DZ                                              REDII
      IF(R2) 4,4,16                                                     REDII
   16 R1 = SQRT(R2)                                                     REDII
      ACOS=(DX*XAN+DY*YAN+DZ*ZAN)/R1                                    REDII
      BCOS=-(DX*XBN+DY*YBN+DZ*ZBN)/R1                                   REDII
       IF( ACOS) 41,41,2                                                REDII
   41 IF (ABS(TH(I))-90.)  43,4,4                                       REDII
   43  F1=0.0                                                           REDII
       GO TO 212                                                        REDII
    2  IF(BCOS) 47,47,3                                                 REDII
   47 IF (ABS(TH(I))-90.) 43,4,4                                        REDII
    3 DYBP=0.0                                                          REDII
      IF(DY) 19,20,19                                                   REDII
   20 DY=1.0E-3*DHB                                                     REDII
      DYBP=DY                                                           REDII
      YB=YA+DYBP                                                        REDII
   19 AY=(DX*DY)/(DY*DY)+(DZ*DZ)/(DY*DY)                                REDII
      XY=(XA*YB-YA*XB)/DY                                               REDII
      ZY=(ZA*YB-YA*ZB)/DY                                               REDII
       DO 116 K = 1, NF                                                 REDII
       RCI1 = RFA(K) + (RFB(K)-RFA(K))*(YS1(I)-YFA(K))/(YFB(K)-YFA(K))  REDII
```

```
      RCI2 = RFA(K) + (RFB(K)-RFA(K))*(YS2(I)-YFA(K))/(YFB(K)-YFA(K))    REDII 116
      IF (ABS(RCI1-RS1(I))-1.0E-3) 118,118,200                            REDII 117
  118 IF (ABS(RCI2-RS2(I))-1.0E-3) 100,100,200                            REDII 118
  100 GO TO 116                                                           REDII 119
  200 DFR=RFB(K)-RFA(K)                                                   REDII 120
      DFY=YFB(K)-YFA(K)                                                   REDII 121
      RY=(RFA(K)*YFB(K)-YFA(K)*RFB(K))/DFY                                REDII 122
      AF=AY-(DFR/DFY)**2                                                  REDII 123
      BF=2.*(DX*XY/DY+DZ*ZY/DY-DFR*RY/DFY)                                REDII 124
      CF=XY*XY+ZY*ZY-RY*RY                                                REDII 125
      DF=BF*BF-4.*AF*CF                                                   REDII 126
      IF(DF) 116,11,11                                                    REDII 127
   11 DF12=SQRT(DF)                                                       REDII 128
      YF(1)=0.5*(-BF+DF12)/AF                                             REDII 129
      YF(2)=-0.5*(BF+DF12)/AF                                             REDII 130
      DO 15 L=1,2
       IF( YF(L) -YB ) 15,13,13                                           REDII 131
   13  IF ( YF(L) -YFB(K)) 14,14,15                                       REDII 132
   14  IF ( YF(L) - YFA(K)) 15,4,4                                        REDII 133
   15 CONTINUE                                                            REDII 134
  116  CONTINUE                                                           REDII 135
      IF ( SHAD ) [illegible]57,1057, 1060                                REDII 136
 1060  DO 3000 IANG = 1,ICUCT                                             REDII 137
      SANG=SIN(THET(IANG))                                                REDII 138
      CANG=COS(THET(IANG))                                                REDII 139
      IF (ABS(SANG)-1.0E-4)  1120,1120,1130                               REDII 140
 1120  IF(THET(IANG) -1.5708 ) 1121,1121,1122                             REDII 141
 1121  SANG = 0.0000000                                                   REDII 142
       CANG = 1.0000000                                                   REDII 143
      GO TO 1123                                                          REDII 144
 1122   SANG = 0.0000000                                                  REDII 145
      CANG= - 1.0000000                                                   REDII 146
 1123 IF( ZB -ZA ) 1140,3000,1140                                         REDII 147
 1140   YPP = YA - ( YB - YA) * ZA/(ZB -ZA )                              REDII 148
      XPP = XA - (XB -XA)*ZA/ (ZB -ZA)                                    REDII 149
      IF( THET( IANG) -0.0) 1142,1142,1144                                REDII 150
 1142  IF ( XPP) 3000,3000,1310                                           REDII 151
 1144 IF( XPP) 1310,3000,3000                                             REDII 152
 1130 IF(ABS(SANG)-0.9999) 1150,1150,1150                                 REDII 153
 1150 IF(THET(IANG) -PIE) 1151,1151,1152                                  REDII 154
 1151 SANG = 1.0000000                                                    REDII 155
      CANG =0.0000000                                                     REDII 156
       GO TO 1153                                                         REDII 157
 1152  SANG = - 1.0000000                                                 REDII 158
      CANG = 0.0000000                                                    REDII 159
 1153   IF( XB -XA ) 1170,3000,1170                                       REDII 160
 1170  YPP = YA -XA*(YB -YA)/(XB -XA)                                     REDII 161
      ZPP = ZA-XA*(ZB -ZA)/ (XB -XA)                                      REDII 162
      XPP=0.0                                                             REDII 163
      IF ( SANG) 1172,1172,1174                                           REDII 164
 1174   IF( ZPP) 3000,3000,1310                                           REDII 165
 1172  IF(ZPP) 1310,3000,3000                                             REDII 166
 1160  IF( XB-XA) 1180,1190,1180                                          REDII 167
 1190   IF( YB -YA) 1200,1210,1200                                        REDII 168
 1200   IF(ZB - ZA) 1230,3000,1230                                        REDII 169
 1230  ZPP = XA*SANG/CANG                                                 REDII 170
      YPP = YA+ (YB-YA)*(ZPP-ZA)/(ZB-ZA)                                  REDII 171
                                                                          REDII 172
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      XPP = XA
 1238 IF( SANG) 1231,1231,1232
 1231 IF(ZPP) 1233,3000,3000
 1233 IF (CANG) 1234,1234,1235
 1234   IF( XPP) 1310,3000,3000
 1235 IF(XPP) 3000,3000,1310
 1232   IF(ZPP) 3000,3000,1233
 1210  IF( ZB -ZA) 1240,3000,1240
 1240  ZPP = XA*SANG /CANG
      YPP =YA
      XPP = XA
      GO TO 1238
 1180  IF( YB -YA) 1250,1260,1250
 1250 IF (ZB -ZA ) 1270,1280,1270
 1270 DENO = (XB-XA)*SANG/CANG   -(ZB-ZA)
      IF(DENO) 1290,3000,1290
 1290 XPP = (ZA*XB -ZB*XA)/ DENO
      YPP = YA +( YB -YA) *(XPP-XA)/(XB-XA)
      ZPP = ZA + (ZB -ZA)*(XPP -XA)/( XB-XA)
      GO TO 1238
 1280  XPP = ZA*CANG/SANG
       YPP = YA +(XPP-XA)*(YB -YA) / (XB -XA)
      ZPP = ZA
       GO TO 1238
 1260   IF( ZB -ZA) 1270,1300,1270
 1300 YPP = YA
       ZPP = ZA
       XPP = ZA* CANG/SANG
       GO TO 1238
 1310 RPP = SQRT(XPP**2+ZPP**2)
      AA = (RCOR1 -RCOR2) /( YCOR2 -YCOR1 )
      CC = (RCOR2*YCOR1 -RCOR1*YCOR2) /(YCOR2 -YCOR1)
       DIST = DIS(AA,CC,YPP,RPP)
      IF( DIST) 3000,1335,1320
 1320  AA=(RCOR4 -RCOR3)/(YCOR3 -YCOR4)
       CC=(RCOR3*YCOR4 -RCOR4*YCOR3) /(YCOR3 -YCOR4 )
      DIST =DIS(AA,CC,YPP,RPP)
      IF(DIST) 1325,1335,3000
 1325  AA=(RCOR4 -RCOR1)/( YCOR1 -YCOR4)
      CC= (RCOR1*YCOR4 -RCOR4*YCOR1)/(YCOR1 -YCOR4)
      DIST = DIS(AA,CC,YPP,RPP)
      IF( DIST) 3000,1335,1330
 1330 AA=(RCOR3 -RCOR2) /(YCOR2 -YCOR3)
       CC= (RCOR2*YCOR3 -RCOR3*YCOR2)/(YCOR2 -YCOR3)
      DIST = DIS(AA,CC,YPP,RPP)
      IF( DIST ) 1335,1335,3000
 1335   IF (YPP-YB) 3000,4,4
 3000 CONTINUE
 1057   F1 = ACOS*BCOS*DA /(PIE*R2)
      GO TO 5
    4 F1=0.0
    5    FAB = FAB + F1
  212  YB = YB - DYBP
   25  CONTINUE
      FAB=2.0*FAB
      IF(FPIETA .EQ. 0) GO TO 20001
      IF(LINEF .GE. 58) CALL RITE(LINEF)
```

```
      WRITE(F,10002) NODE(I),FAB                                        REDI  230
      LINEF=LINEF+1                                                     REDI  231
28801 LLL=LLL+1                                                         REDI  232
      FE(N,LLL)=FA3*1.0E5                                               REDI  233
    7 CONTINUE                                                          REDI  234
   30 CONTINUE                                                          REDI  235
      RETURN                                                            REDI  236
      END                                                               REDI  237
```

```
      FUNCTION DIS(AA1,CC1,VPP1,RPP1)
      DEO=SQRT(AA1**2+1.0)                                              DIS    2
      COA=AA1/DEO                                                       DIS    3
      SIA=1.0/DEO                                                       DIS    4
      PP = - 1.* CC1/DEO                                                DIS    5
      DIS = VPP1*COA  +RPP1*SIA -PP                                     DIS    6
      RETURN                                                            DIS    7
      END                                                               DIS    8
                                                                        DIS    9
```

```
      SUBROUTINE RITE(LINEF)
      WRITE(5,1)
    1 FORMAT(1H1,26X,"SYSTEM EXTERNAL VIEW FACTORS",//)              RITE   2
      LINEF=4                                                        RITE   3
      RETURN                                                         RITE   4
      END                                                            RITE   5
                                                                     RITE   6
                                                                     RITE   7
```

```
      SUBROUTINE VECANG(X1,Y1,X2,Y2,VECT,THETA,NTOT1)                  VECANG   2
      DIMENSION X1(1),Y1(1),X2(1),Y2(1),VECT(1),THETA(1)              VECANG   3
      DO 1 I=1,NTOT1                                                   VECANG   4
      IF(X2(I) .NE. X1(I)) GO TO 2                                     VECANG   5
      IF(VECT(I) .GT. 0.0) GO TO 3                                     VECANG   6
      THETA(I)=-90.0                                                   VECANG   7
      GO TO 1                                                          VECANG   8
    3 THETA(I)=90.0                                                    VECANG   9
      GO TO 1                                                          VECANG  10
    2 IF(Y2(I) .NE. Y1(I)) GO TO 4                                     VECANG  11
      IF(VECT(I) .GT. 0.0) GO TO 5                                     VECANG  12
      THETA(I)= 180.0                                                  VECANG  13
      GO TO 1                                                          VECANG  14
    5 THETA(I)=0.0                                                     VECANG  15
      GO TO 1                                                          VECANG  16
    4 THET=ATAN((ABS(Y2(I)-Y1(I))/ABS(X2(I)-X1(I))))*180.0/3.14159     VECANG  17
      IF(Y1(I) .GT. Y2(I)) GO TO 6                                     VECANG  18
      IF(VECT(I) .GT. 0.0) GO TO 7                                     VECANG  19
      THETA(I)=-180.0+THET                                             VECANG  20
      GO TO 1                                                          VECANG  21
    7 THETA(I)=THET                                                    VECANG  22
      GO TO 1                                                          VECANG  23
    6 IF(VECT(I) .GT. 0.0) GO TO 8                                     VECANG  24
      THETA(I)=180.0- THET                                             VECANG  25
      GO TO 1                                                          VECANG  26
    8 THETA(I)=-THET                                                   VECANG  27
    1 CONTINUE                                                         VECANG  28
      RETURN                                                           VECANG  29
      END                                                              VECANG  33
```

```
      OVERLAY(YRHP,14,2)                                                TAIL2     2
      PROGRAM TAIL2                                                     TAIL2     3
      COMMON/PLM/QB(5000)                                               TAIL2     4
      COMMON/ALL/ N,NN,NNN,ISURF(50),NODE(50),JSURF(5,2),XF(5),NTOT1,   TAIL2     5
     *                NOC,NP(10), AREA(80)                              TAIL2     6
      COMMON /TAIL/ NF,YFA(30),YFB(30),RFA(30),RFB(30),TPL,EMM(50)      TAIL2     7
      COMMON /TWX/ TW(80)                                               TAIL2     8
      COMMON/GG/ MHS,MHSBS,MHSB(6)                                      TAIL2     9
      COMMON /PRINT/ PRINT1, PRINT2, PRINT3, PRINT4, PRINT5,            TAIL2    10
     *               PRINT6, PRINT7, PRINT8, PRINT9, PRINT0             TAIL2    11
      DIMENSION   FE(30,50),        F(50,50), X1(55),  Y1(55), X2(55),  TAIL2    12
     *        Y2(55), VECT(55), YF(10,20), RF(10,20)                    TAIL2    13
      COMMON/T/ THA(20),K5C,NAS,NWL,NPLOT                               TAIL2    14
      INTEGER PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8   TAIL2    15
     1,PRINT9,PRINT0                                                    TAIL2    16
      EQUIVALENCE (QB(1),FE(1)),(QB(1501),F(1)),(QB(4001),X1(1)),       TAIL2    17
     1(QB(4056),Y1(1)),(QB(4111),X2(1)),(QB(4166),Y2(1)),(QB(4221),     TAIL2    18
     2VECT(1)),              (QB(4281),YF(1)),(QB(4681),RF(1))          TAIL2    19
  300 CALL PROI(NTOT1,NAS,THA,AREA,F,FE,EMM,TW,QB,NWL,NPLOT)            TAIL2    20
      END                                                               TAIL2    21
```

```
      FUNCTION PLANCK(T,W)                                    PLANCK2    2
      DATA C1,C2/1.1909E-12,1.4388/                           PLANCK2    3
      X=C2*W/T                                                PLANCK2    4
      IF(X.LT.172.)GO TO 10                                   PLANCK2    5
    5 PLANCK=0.                                               PLANCK2    6
      RETURN                                                  PLANCK2    7
   10 PLANCK=(C1*W*W*W)/(EXP(X)-1.)                           PLANCK2    8
      RETURN                                                  PLANCK2    9
      END                                                     PLANCK2   10
```

```
      SUBROUTINE REDI(N,NANG,TH,AR,F,FE,RH,T,QB,NWL,NPLOT)
      DIMENSION FE(30,50),QB(1),F(50,50),AR(1),RH(1),LLL(50),ERI(20),
     1MLL(50),P(4),U(4),AM(50,50),E(50,50)
      DIMENSION TH(30), T(80)
      COMMON /PRINT/ PRINT1, PRINT2, PRINT3, PRINT4, PRINT5,
     *                PRINT6, PRINT7, PRINT8, PRINT9, PRINT0
      INTEGER PRINT1,PRINT2,PRINT3,PRINT4,PRINT5,PRINT6,PRINT7,PRINT8
     1,PRINT9,PRINT0
      COMMON /OUT/ AREA(20),TMAX(20),ANG(20),ITOT
      COMMON /EE/ BAND1,BAND2, SUM(20)
      DATA ERI/20*1H /
      DATA P/ ,1739274,,3260726,,3260726,,1739274/
      DATA U/-,4305682,-,1699905,,1699905,,4305682/
                     DATA S0/0,02/
      DO 230 I=1,N
  230 RH(I)=1.0-RH(I)
      C1=1.187*(10.**8)/3.41276
      C2=25*R5,
      RE=630.,
      RS=RE*FE/144,
      CF=1./(10.**5)
      NS=N
      READ(5,49) BAND1,BAND2
   49 FORMAT(2F10,5)
  283 DO 2 I=2,NS
      IP=I-1
      DO 1 J=1,IP
    1 F(I,J)=AR(J)*F(J,I)/AR(I)
    2 CONTINUE
      DO 3 I=1,NS
      DO 3 J=1,NS
      IF(I-J) 4,5,4
    4 DIJ=0.
      GO TO 3
    5 DIJ=1.
    3 AM(I,J)=DIJ-RH(I)*F(I,J)
      CALL MINV (AM,N,50,LLL,MLL)
      DO 8 J=1,NS
      ONEM=1.0-RH(J)
      DO 8 I=1,NS
    8 AM(I,J)=AM(I,J)*ONEM
      DO 10  I=1,NANG
      DO 96 J=1,NS
      E(I,J)=0.
      DO 9 K=1,NS
    9 E(I,J)=E(I,J)+FE(I,K)*AM(K,J)
   96  E(I,J) =CF* E(I,J)
   10 CONTINUE
      DO 120 I=1,NANG
      QBMX=0.0
      WL=1.0
      DO 21 M=1,NWL
      QBL=0.00
      DO 14 J=1,NS
      VI=0.0
      DO 98 ID=1,4
      X=(S0)*U(ID))+WL
```

```
      VIP=1.0/((X**5)*(EXP(C2/(X*T(J)))-1.0))
   98 VI=VI+(R(IO)*VIP)
      VI=C1*SO*VI
   18 QBL=QBL+(E(I,J)*VI*RS)
      OB(M)=QBL
      IF(QBL.LT.QBMX)  GO TO 20
      QBMX=QBL
      WLSAVE=WL
   20 WL=WL+SO
      IF (PRINT9.EQ.0)  GO TO 100
      CALL RITER1(QB,TH(I),NWL)
  100 THAX(I)=2*97.9/WLSAVE
      IF(WLSAVE+SO .GT. WL-SO) ERI(I)=10H-*** CHECK
      CALL SUMAT1(TH(I),Q3,NWL,I,PRINT9,NPLOT)
  120 CONTINUE
      ITOT=NANG
      WRITE(6,60) BAND1,BAND2
   60 FORMAT(1H1/1H039X*HOT METALS*
     $          /36X*BANDWIDTH SUMMATION*/33XF6.2,* -*F6.2,* MICRONS*
     A/1H05X*OFF AXIS     BANDWIDTH*3(9X*EQUIVALENT*)/
     B7X*ANGLE       RADIATION*3(9X*BLACK BODY*)/
     C7X*(DEG.)           (W/ST.)         TEMPERATURE (K)      AREA (CM**2)
     D    RADIATION (W/ST.) *)
      DO 61 I=1,ITOT
   61 WRITE (6,62) ANG(I), SUM(I), TMAX(I), AREA(I), SUM(I), ERI(I)
   62 FORMAT(1H0,F14.1,F13.3,2F19.2,F19.3,6X,A10)
      RETURN
      END
```

```
      SUBROUTINE MINV(A,N,NM,L,M)                                    MINV   2
      DIMENSION A(1),L(1),M(1)                                       MINV   3
      NK=-NM                                                         MINV   4
      DO 80 K=1,N                                                    MINV   5
      NK=NK+NM                                                       MINV   6
      L(K)=K                                                         MINV   7
      M(K)=K                                                         MINV   8
      KK=NK+K                                                        MINV   9
      BIGA=A(KK)                                                     MINV  10
      DO 20 J=K,N                                                    MINV  11
      IZ=NM*(J-1)                                                    MINV  12
      DO 20 I=K,N                                                    MINV  13
      IJ=IZ+I                                                        MINV  14
   10 IF(ABS(BIGA)-ABS(A(IJ))) 15,20,20                              MINV  15
   15 BIGA=A(IJ)                                                     MINV  16
      L(K)=I                                                         MINV  17
      M(K)=J                                                         MINV  18
   20 CONTINUE                                                       MINV  19
      J=L(K)                                                         MINV  20
      IF(J-K) 35,35,25                                               MINV  21
   25 KI=K-NM                                                        MINV  22
      DO 30 I=1,N                                                    MINV  23
      KI=KI+NM                                                       MINV  24
      HOLD=-A(KI)                                                    MINV  25
      JI=KI-K+J                                                      MINV  26
      A(KI)=A(JI)                                                    MINV  27
   30 A(JI)=HOLD                                                     MINV  28
   35 I=M(K)                                                         MINV  29
      IF(I-K) 45,45,38                                               MINV  30
   38 JP=NM*(I-1)                                                    MINV  31
      DO 40 J=1,N                                                    MINV  32
      JK=NK+J                                                        MINV  33
      JI=JP+J                                                        MINV  34
      HOLD=-A(JK)                                                    MINV  35
      A(JK)=A(JI)                                                    MINV  36
   40 A(JI)=HOLD                                                     MINV  37
   45 IF(BIGA) 48,150,48                                             MINV  38
   48 DO 55 I=1,N                                                    MINV  39
      IF(I-K) 50,55,50                                               MINV  40
   50 IK=NK+I                                                        MINV  41
      A(IK)=A(IK)/(-BIGA)                                            MINV  42
   55 CONTINUE                                                       MINV  43
      DO 65 I=1,N                                                    MINV  44
      IK=NK+I                                                        MINV  45
      IJ=I-NM                                                        MINV  46
      DO 65 J=1,N                                                    MINV  47
      IJ=IJ+NM                                                       MINV  48
      IF(I-K) 60,65,60                                               MINV  49
   60 IF(J-K) 62,65,62                                               MINV  50
   62 KJ=IJ-I+K                                                      MINV  51
      A(IJ)=A(IK)*A(KJ)+A(IJ)                                        MINV  52
   65 CONTINUE                                                       MINV  53
      KJ=K-NM                                                        MINV  54
      DO 75 J=1,N                                                    MINV  55
      KJ=KJ+NM                                                       MINV  56
      IF(J-K) 70,75,70                                               MINV  57
   70 A(KJ)=A(KJ)/BIGA                                               MINV  58
```

```
   75 CONTINUE                                              MINV   59
          A ( K K ) = 1. / BI GA                            MINV   60
   80 CONTINUE                                              MINV   61
      K=N                                                   MINV   62
  100 K=(K-1)                                               MINV   63
      IF(K) 150,150,105                                     MINV   64
  105 I=L(K)                                                MINV   65
      IF(I-K) 120,120,108                                   MINV   66
  108 JQ=NM*(K-1)                                           MINV   67
      JR=NM*(I-1)                                           MINV   68
      DO 110 J=1,N                                          MINV   69
      JK=JQ+J                                               MINV   70
      HOLD=A(JK)                                            MINV   71
      JI=JR+J                                               MINV   72
      A(JK)=-A(JI)                                          MINV   73
  110 A(JI)=HOLD                                            MINV   74
  120 J=M(K)                                                MINV   75
      IF(J-K) 100,100,125                                   MINV   76
  125 KI=K-NM                                               MINV   77
      DO 130 I=1,N                                          MINV   78
      KI=KI+NM                                              MINV   79
      HOLD=A(KI)                                            MINV   80
      JI=KI-K+J                                             MINV   81
      A(KI)=-A(JI)                                          MINV   82
  130 A(JI)=HOLD                                            MINV   83
      GO TO 100                                             MINV   84
  150 RETURN                                                MINV   85
      END                                                   MINV   86
```

```
      SUBROUTINE RITER1(Q,TH,NWL)                                          RITER1   2
      DIMENSION Q(1,1)                                                     RITER1   3
      NL=NWL/5                                                             RITER1   4
      NLT=NL*5                                                             RITER1   5
      NLTP=NLT+1                                                           RITER1   6
      WLF=NLT/250.                                                         RITER1   7
        I=1                                                                RITER1   8
    4 WRITE(5,1)                                                           RITER1   9
    1 FORMAT(1H1,38X,"RADIANT INTENSITY, NO ATMOSPHERIC ATTENUATION")      RITER1  10
      WRITE(6,9) TH                                                        RITER1  11
    9 FORMAT(47X,16HOFF-AXIS ANGLE= ,F4.1,5H DEG.,/,1X,5(5X,4HWAVE,6X,8H   RITER1  12
     1SPECTRAL),/,1X,5(4X,6HLENGTH,4X,9HRADIATION),/,5(4X,8H(MICRON),4X,   RITER1  13
     27H(W/ST.)))                                                          RITER1  14
      WL=1.00                                                              RITER1  15
      DO 6 J=1,NL                                                          RITER1  16
      WL2=WL+WLF                                                           RITER1  17
      WL3=WL2+WLF                                                          RITER1  18
      WL4=WL3+WLF                                                          RITER1  19
      WL5=WL4+WLF                                                          RITER1  20
      K=J+NL                                                               RITER1  21
      L=K+NL                                                               RITER1  22
      M=L+NL                                                               RITER1  23
      N=M+NL                                                               RITER1  24
      WRITE(6,2) WL,Q(I,J),WL2,Q(I,K),WL3,Q(I,L),WL4,Q(I,M),WL5,Q(I,N)     RITER1  25
    6 WL=WL+0.02                                                           RITER1  26
      IF(NLTP.GT.NWL)  GO TO 55                                            RITER1  27
      WL=WL5                                                               RITER1  28
      DO 13 J=NLTP,NWL                                                     RITER1  29
      WL=WL+0.02                                                           RITER1  30
   13 WRITE(6,3) WL,Q(I,J)                                                 RITER1  31
    2 FORMAT(5(5X,F5.2,5X,F8.3))                                           RITER1  32
    3 FORMAT(97X,F5.2,5X,F8.3)                                             RITER1  33
   55 RETURN                                                               RITER1  34
      END                                                                  RITER1  35
```

```
      SUBROUTINE SUMAT1(TH,QB,NWL,I,IPT,IPLT)
      DIMENSION QB(1)
      COMMON /OUT/ AREA(20),TMAX(20),ANG(20),ITOT
      COMMON /EE/ BAND1,BAND2, SUM(20)
      WNS=10000./BAND2
      WNE=10000./BAND1
      DEL=WNE-WNS
      NP=DEL/50.+1
      SS=DEL/NP
      WN=WNS-0.5*SS
      AREA(I)=0.0
      DO 200 L=1,NP
      WN=WN+SS
  200 AREA(I)=AREA(I)+PLANCK(TMAX(I),WN)*SS
      ANG(I)=TH
      IS=(BAND1-1.0)/0.02+1.0000005
      IE=(BAND2-1.0)/0.02+0.0000005
      WL=0.98+IS*0.02
      DIFF=WL-BAND1
      VAL=0.5+(50.*DIFF)
      SUM(I) = VAL*QB(IS)
      L=IS+1
      DO 103 LL=L,IE
  103 SUM(I) = SUM(I)+QB(LL)
      L=IE+1
      WL=0.98+L*0.02
      DIFF=WL-BAND2
      VAL=3.5+(50.*DIFF)
      SUM(I) = SUM(I)+VAL*QB(L)
      AREA(I)=SUM(I)/AREA(I)
      IF(IPT.EQ.0)  GO TO 100
      WRITE(6,15)     BAND1,    BAND2,     SUM(I)
   15 FORMAT(1H0,9X *BANDWIDTH SUMMATION*,5X,*BANDWIDTH*F6.2,2H -,F6.2,
     15X,*RADIATION*,F8.3,* W/ST.*)
  100 IF(IPLT.EQ.0 .OR. TH.GT.89.5)  RETURN
      WL=0.98+IS*0.02
      NP=IE-IS+2
      DO 60 L=1,NP
      LL=L+999
      QB(LL)=WL
      LL=LL+NP
      LS=L+IS
      QB(LL)=QB(LS)
      WN=10000./WL
      LL=LL+NP
      SS=10000./(WL-0.01)-10000./(WL+0.01)
      QB(LL)=PLANCK(TMAX(I),WN)*AREA(I)*SS
   60 WL=WL+0.02
      CALL PLOT1 (TH,QB(1000),NP,3,40,0)
      RETURN
      END
```